WORLD OIL

Keys to Successful Competitive Drilling
Page 91
Universal Theory of Reservoir Engineering
Page 119
[illegible]'s Bright Spot Is Southern Zone
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Page 151

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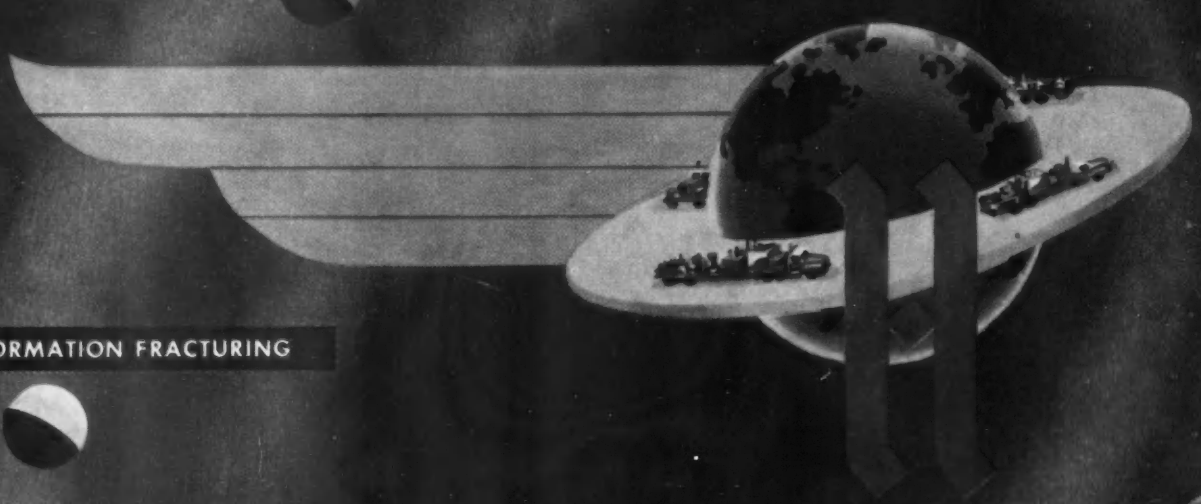

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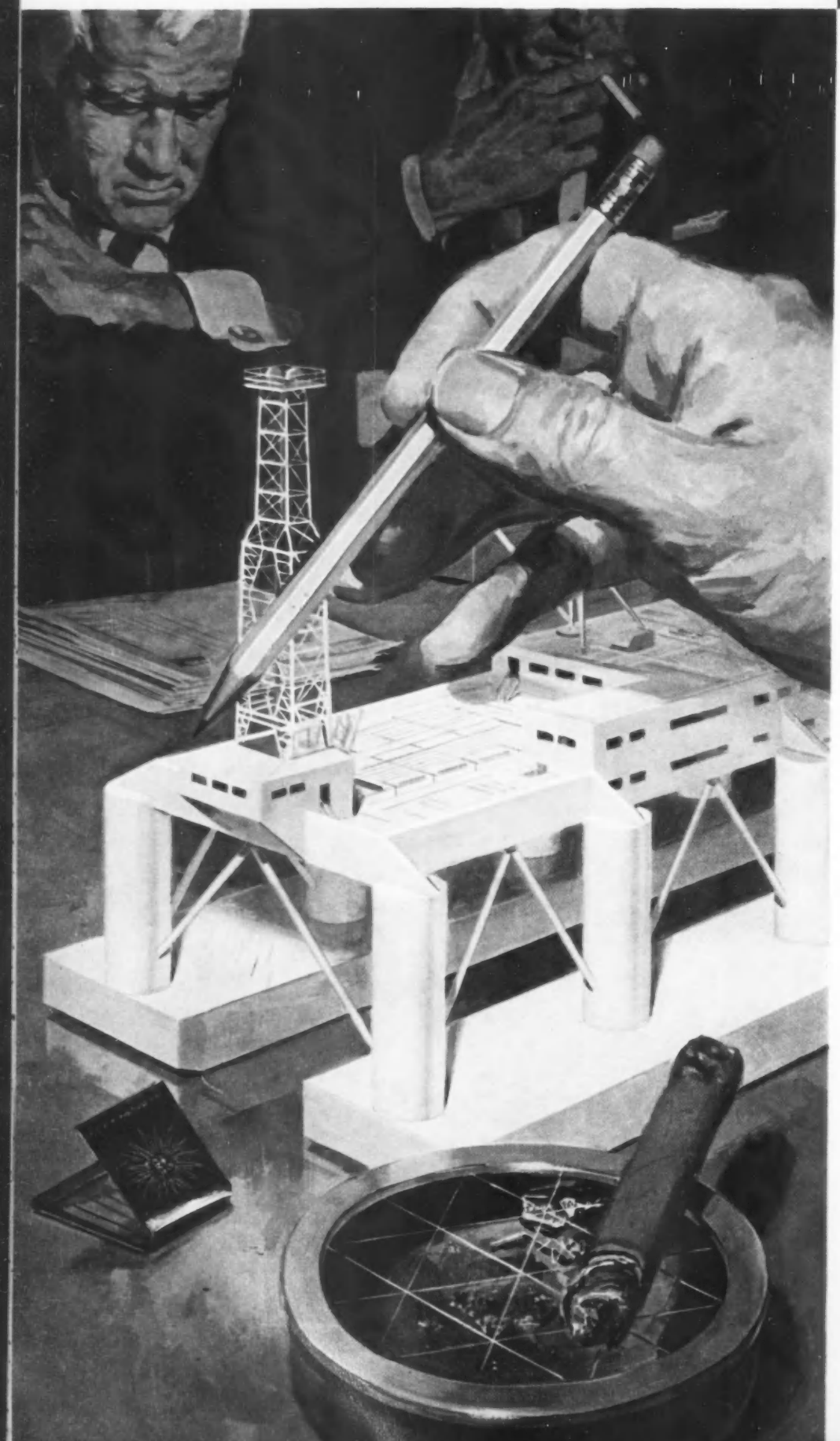

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Volume 145, No. 4 September, 1957

CURRENT OUTLOOK SECTION

		Page
Looking Ahead		45
Editor's Page		49
New Mexico Area Offers Thick Ellenburger Pay	H. H. King	50
How We Licked Oil Cost Accounting	Marshall E. Dunn	53
How to Ruin a Staff Meeting	J. Damon Quinton	62
If Oil Could Speak		64
Management Faces Challenge in New Industrial Trends	E. P. Brooks	65
CHANGING PANORAMA: Oil Industry Investment in U. S. Reaches $54.5 Billion	L. J. Logan	69
Oil Industry Earnings Up 17 Percent in First Half		70
Report from the Observatory	Ray L. Dudley and Warren L. Baker	72
Petroleum Trends in U. S.		72
Drilling Activities	Cecil W. Smith	74

EXPLORATION SECTION

Digital Computers Can Help Geophysicists	Thomas J. Bevan and Paul W. Fullerton	79
Pinpointing Panhandle Possibilities	Carl A. Moore	83
Influence of Coriolis Force on River Profiles	V. G. Gabriel, Lester Brockman and Donald F. Haber	89

DRILLING SECTION

Keys to Successful Competitive Drilling (Part 5-A)	Roy A. Bobo and Robert S. Hoch	91
New Equipment Designed for Creole's Blowout Control	J. E. Ortloff and E. H. Clark	100
Fundamentals of Electric Power Transmission for Drilling Rigs (Part 3)	Glenn W. Webb	106
A Discussion of Electric Log Interpretation in Shaly Sands	Leendert de Witte	114

PRODUCTION SECTION

A Universal Theory of Oil Reservoir Engineering (Part 1)	Dr. S. J. Pirson	119
"Graph System" Gives Gas Lift a Lift (Part 2)	E. D. McMurry	125
New Fracturing Increases Injection Rate		136
Production Testing of Electrified Wells	John W. Lambert	140
Stimulation of Mississippi Chat in Kansas	A. J. Etchen	145

INTERNATIONAL SECTION

South Zone Bright Spot in Mexico	Louis M. Gasche	151
Interest Grows in Oil's Legal Problems Abroad	Burney Braly	153
A World of Oil	Don Kliewer	159
What's Happening Among World Oil Men		166

DEPARTMENTS

Who's Meeting Where		43
Drilling Hints		168
Production Hints		182
What's Happening Among Men in the Industry		192
Companies in the News		206
New Books		210
Association News		214
What's Happening Among Service and Supply Men		222
Trading Post		250
Classified Advertising Page		250
Squeaks from the Bullwheel		254

NEW EQUIPMENT SECTION

What's New in Equipment		260
New Equipment Catalogs and Literature		273
ADVERTISERS' INDEX		274

WORLD OIL

Established 1916 as The OIL WEEKLY

a quick look at WORLD OIL this month

BUSY OIL MEN: To help you put first things first, scan these time-saving digests on this and the following pages, checking ☑ those you want to read first.

CURRENT OUTLOOK

☐ **A high yield in volumes of oil** characterizes the new Justis-Ellenburger pool, Lea County, recently opened by Tidewater Oil Company. It is one of the most important discoveries in southeast New Mexico in recent years. The pool will be of limited area, as indicated by several adjacent deep dry holes, but production will be high. The discovery well is producing from an exceptionally thick section of Ellenburger pay. Turn to **Page 50. New Mexico Area Offers Thick Ellenburger Pay**.....**H. H. King**

☐ **The acid test of any cost system** is whether or not it is actually used and used to advantage. This test has been passed by the cost system of a medium-sized independent oil producing company of California. The results are being used by the company's superintendents, its petroleum engineers and its top management. The cost system was built from scratch by a relatively small accounting force. For a description of how the system works and how the information it develops is reported to management, see **Page 53. How We Licked Oil Cost Accounting**.....**Marshall E. Dunn**

☐ **Bore your listeners to sleep** at the next staff meeting. Twenty-five sure-fire "rules to ruin" for a meeting leader are presented effectively on **Page 62.** Check and see how many apply to you. **How to Ruin a Staff Meeting**.....**J. Damon Quinton**

Turn the Page ▸

This Month . . .

☐ **For a crystal ball forecast of the problems** to be faced by tomorrow's top management, read this article by one of the nation's foremost authorities on industrial management. The engineers, supervisors and foremen of today will form the nucleus of that top management. What will be the determining factors in your thinking? You will find the answer to this and many more thought-provoking questions in this timely discussion of new management trends on **Page 65. Management Faces Challenge in New Trends**.....
E. P. Brooks

☐ **Capital expenditures of over $6 billion** in the U. S. in 1956, an increase of almost $½ billion over the amount spent in 1955 were made by the petroleum industry. The total included over $4 billion or 72 percent for production. At the end of 1956, the industry's gross investment in the U. S. had increased to $54.5 billion, including $43.7 in property, plant and equipment. The latter figure included $25 billion or 57 percent in crude oil and natural gas production. See **Page 69. Oil Industry Investment in U. S. Reaches $54.5 Billion**.....**L. J. Logan**

☐ **The petroleum industry of the U. S.** as a whole earned about 17 percent more profits in the first half of 1957 than in the like period of 1956. The earnings in the second quarter were about 16 percent above last year. In the first quarter they had been about 19 percent above 1956. This year's favorable earnings have been caused by higher crude oil and refined products since last January and by the large, emergency exports to Europe during the Suez Canal closure. **Oil Industry Earnings Up 17 Percent in First Half**.....**Page 70**

☐ **Very little relief is in sight** for U. S. crude oil producers, although higher petroleum demand and the possibility of reduced imports promise improved outlook in coming months. Excessive stocks make it desirable that U. S. producing rates not be increased by any substantial amount.

Consequently, U. S. oil producers are not likely to experience much relief from recent drastic production cuts. Even a 200,000 barrel per day gain in total U. S. production over the next four months would make little difference by the time it is divided among thousands of producers and a much larger number of wells. Hence, low per well producing allowables will continue to plague U. S. producers. **Page 72. Little Relief Seen for U. S. Producers . . . Ray L. Dudley and Warren L. Baker.**

WORLD OIL, published every month except semi-monthly in February and August. Entered as THE OIL WEEKLY as second class mail matter December 23, 1916, at postoffice at Houston, Texas, under the act of March 3, 1879.

EXPLORATION ARTICLES

☐ **Vast savings, time and manpower wise,** are available through the digital computer. The intelligent application of this instrument offers a wide field of application to the geophysicist. For a story on the potential this machine offers the geophysicists, see **Page 79. Digital Computers Can Help Geophysicists**.....
Thomas J. Bevan and Paul W. Fullerton

☐ **A great number of petroleum exploration** techniques are being used in the search for oil in the Texas Panhandle and Oklahoma. Current emphasis is being placed on locating a favorable geological area, or province, and then adapting the proper exploration tools to the problem of finding oil in that favorable area. A story of the techniques used will be seen on **Page 83. Pinpointing Panhandle Possibilities**..
Carl A. Moore

☐ **The age-old question of the effect** of centrifugal force, mechanical and chemical weathering and wind intensity upon the transversal profiles of a river is discussed in the article on **Page 89. Influence of Coriolis Force on River Profiles**.....**V. G. Gabriel, Lester Brockman and Donald F. Haber**

DRILLING ARTICLES

☐ **The rotary drilling circulatory system** is examined in light of its intended purpose with full consideration of the pressure losses involved. This long awaited continuation of the popular series **Keys to Successful Competitive Drilling** is complete with equations and charts for both turbulent and laminar flow. Turn to **Page 91** for **Part 5-A: Rotary Circulating Systems and Their Inherent Pressure Losses**.....
Roy A. Bobo and Robert S. Hoch

☐ **One of the major operators in South America** has spent considerable time and thought on blowout prevention. This has paid off in the design and development of new equipment, standardized procedures and an emergency fire brigade to deal with all blowout situations. The goal now is to interest other companies in joining in this emergency set-up. For further information on the tools, techniques and standardized procedures instituted by this company read beginning **Page 100. New Equipment Designed for Creole's Blowout Control**.....**J. E. Ortloff and E. H. Clark**

☐ **How does a drawworks or mud pump respond** to diesel-electric drive? What is the efficiency of this type of drive? What about speed and torque limit controls? These and other questions on the advantages of diesel electric drive are answered in this final installment on **Page 106. Fundamentals of Electric Power Transmission for Drilling Rigs (Part 3): Electric Drive Application to Rotary Rig Operation**.....**Glenn W. Webb**

☐ **A rebuttal and discussion of some** of the assumptions made in Dr. S. J. Pirson's recent articles on "Formation Evaluation by Log Interpretation" is presented on **Page 114.** For a defense of previous work of log interpretation in shaly sands reads the discussion. **Electric Log Interpretation in Shaly Sands**.....
Leender de Witte

PRODUCTION ARTICLES

☐ **Three fundamental and different processes** by which oil is recovered from its reservoir rock in the earth are depletion drive, water drive and segregation drive. The first two mechanisms are discussed in the first part of a series of articles on **Page 119. A Universal Theory of Oil Reservoir Engineering (Part 1)**..
Dr. S. J. Pirson

☐ **A quick, accurate and simple method** and a handy engineering tool for good gas lift valve installation design is provided with this graphic system. Turn to **Page 125.** The design of different type installations is governed by four well conditions. **Graph System Gives Gas Lift a Lift (Part 2)**....**E. D. McMurry**

☐ **Give fracturing operations a down-hole boost** at the initiating point of fracture with additional hydraulic horsepower from a new fracturing technique. The new tool, a recently introduced power package designed to give higher injection rates at higher pressure with a reduction in friction and fluid loss, has been subjected to a variety of well conditions in field tests. **New Fracturing Tool Increases Injection Rate** .....**Page 136**

(Continued on Page 6)

Next Month . . .

WORLD OIL'S Annual Drilling Progress Issue

U. S. drilling contractors continue to be faced with an unhealthy situation in which costs are rising but keen competition is holding prices received by contractors to a minimum level.

The editorial theme of WORLD OIL's 1957 Drilling Progress Issue has been keyed to above conditions.

► Equipment Maintenance

Because of its prime importance in helping contractors stay in business when faced with higher costs while he receives the same old price for his services, the general theme of this issue will be equipment maintenance.

Top experts in various fields will present discussions on how to prolong the life of various rig parts. Headlining this group of articles will be one which will tell how to establish a good permanent maintenance program, and the roles management, training of men, and proper record keeping must play if it is to be successful.

► Contractor Problems

With drilling contractors drilling about 92 percent of all U. S. wells, it is vital to the industry's over-all welfare that such an important segment be maintained in a healthy condition. Therefore, it is important that all parts of the industry realize the economic problems facing U. S. drilling contractors today.

A highlight of this issue will be a symposium which will round up trends in drilling conditions in all sectors of the nation. Eleven contractors, prominent in different areas, will discuss the situation and what is ahead in his particular region.

► Other Articles, Too

The foregoing will not comprise all the special content prepared for WORLD OIL's annual Drilling Progress Issue. There will be other drilling articles in addition to the usual assortment of articles on current events, geology, production, and international developments.

Nothing will be missing from the issue, the drilling material will be an added attraction.

☐ **Determine the daily oil and water production** by using this testing procedure. A graphic watt demand meter installed in the motor control circuit of electrified pumping wells is used to determine the most efficient pumping cycle. Sample and weigh fluid production and use this data on a copyrighted chart. For details see **Page 140. Production Testing of Electrified Wells**.....**John W. Lambert**

☐ **Stimulation techniques for the treatment** of Mississippi chat in central Kansas have become established through familiarity with the characteristics of the formation. A discussion of the methods that should produce maximum formation stimulation, based on treatment of over 1000 wells in that area is presented on **Page 145. Stimulation of Mississippi Chat in Kansas**.....**A. J. Etchen**

INTERNATIONAL ARTICLES

☐ **An active drilling program,** increasing reserves and other expansions are highlighting Petroleos Mexicanos operations in Mexico's Southern Zone, centering around the Isthmus of Tehuantepec, where 21 producing oil fields are in operation. See **Page 151. South Zone Bright Spot in Mexico**. . .**Louis M. Gasche**

☐ **Many legal problems arise to confront** companies and individuals alike in conducting oil operations abroad. The checklist on **Page 153** lists several of the factors which those planning such operations should consider, according to the experience of their predecessors. **Interest Grows in Oil's Legal Problems Abroad**.....**Burney Braly**

NEW EQUIPMENT

☐ **Before the new has time to get old,** more equipment is offered to the oil industry by the manufacturers. For an up-to-date, concise summary of the latest improvements, see **Page 260.** The regular department is divided into three sections—general, production and drilling. More detailed information is available on the equipment by checking the Readers' Service Card at the back of the book. . . . **What's New in Equipment.**

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Indexed by Industrial Arts Index and Engineering Index

Looking Ahead . . .

Oil Company Earnings Up 17 Percent . . . Reports from 43 oil companies show first half earnings up an average of 17 percent over '56 (See Page 70). Reasons: First of the year increase in crude and product prices—abnormal expansion of demand for crude and fuel oils in supplying Western Europe during Suez crisis.

The upward trend in earnings will be curbed in the second half because of reduced production, exports and refinery runs combined with weakening product prices and increases in labor and material costs.

Snags in Offing for Import Plan . . . Import problem is far from solved. Six companies protested the share allotted them under government plan (10 percent reduction of '54-'56 average, excluding West Coast imports). Elimination of one inequity may create another, starting chain reaction which might sign program's death warrant.

If crude imports are reduced to government's quota of 1,030,000 barrels daily in second half of '57, they must be cut to average of 945,000 barrels per day during last four months of the year.

California Producers Seek Higher Crude Prices . . . Oil Producers Agency of Calif. has plan to jack up the state's four-year slump in drilling and production rates: Hike crude prices 75¢ a barrel.

Group says price boost is needed to offset 35 percent cost increase between '53 and the end of '56, plus other increases resulting from '57 jump in oil industry wages and steel prices.

From '53 to '57, drilling has dropped from 2605 wells to an estimated 2200; production has dropped from 1 million barrels to 930,000. Drilling is off 15 percent; production is down 7 percent.

Higher Drilling Costs Are on the Way . . . Daily operating cost increases of $35 to $45 per day for drilling in "hard rock" country are predicted in the face of recent 12½ percent price increase for drilling bits, according to American Association of Oilwell Drilling Contractors President Jack Abernathy. Increase in bit prices will boost costs from $20.63 to $46.38 for various sizes. New price of 6⅞-inch-7⅞-inch bits is expected to be $185.63 each; and bits from 12⅜-inch-13¾-inch will cost $417.38.

Rotary Rig Activity Tops '56 . . . For the first time this year, total active rotary rigs are passing year ago levels. After dropping to low of 2233 operating on May 6 (456 less than same date last year), U. S. rotary rig activity began upward climb. On August 19 there were 2552 rotaries in operation, an increase of 43 over the same date in '56. Rig activity is expected to make further gains over '56 rates in months ahead.

One Miss and a Possible Hit . . . First well drilled for oil and gas in Vermont, three miles west of St. Albans near Lake Champlain, was shut down at 2000 feet in early August. Using cable tool rig, operators set 1680 feet of 8⅝-inch casing in the hole. Almost continuous shows of gas were encountered, but nothing commercial. Ready market for natural gas could probably be found in vicinity should commercial quantities be discovered.

LOOKING AHEAD . . .

Washington's first potential commercial oil well since the turn of the century has launched one of the biggest land-lease booms in the state's history. Nearly 800 leases have been obtained on about 500,000 acres of state-owned land. Test well, Medina 1, near Ocean City, is owned and operated by Sunshine Mining Co. Drill stem tests indicated 200 barrels daily of clean 46 gravity oil at 4000 feet.

Oil Search Moves to Algeria . . . At least a dozen oil companies are looking at the Sahara Desert area of Algeria. Bids will be taken in October on 23,000 square miles in the neighborhood of recent oil discoveries, and additional acreage will be opened for bids next year.

New 100 Million Barrel "Field"—Sans Crude Oil . . . A 100 million barrel field was formally added to U. S. petroleum reserves early in August. However, crude will not be the basic product. For first time in its history, the U. S. oil industry witnessed start-up of a $16 million operation designed for the commercial recovery of high quality oil products from a substance other than crude.

Gilsonite, a shiny black hydrocarbon found in deep vertical veins extending for miles along the ground in the Uintah Basin of eastern Utah, is mined with hydraulically powered equipment. It is crushed to size and shipped with water in slurry form through a 72-mile, 6-inch pipe line to a new refinery near Grand Junction, Colorado.

Refinery can handle 700 tons of gilsonite daily, produce 1300 barrels per day of high quality gasoline and 250-275 tons per day of high grade metallurgical coke, plus plant fuel and gas. New enterprise is owned by American Gilsonite Co. which is jointly owned by Standard Oil of California and Barber Oil Corp.

Asphalt Market Looks Promising . . . U. S. asphalt demand likely will reach 136 million barrels annually by 1962, three times greater than in '46. Paving asphalt will account for about 105 million of this total due to $100 billion federal highway program.

Plan to curb U. S. oil imports may run counter-wise to road building program. Large portion of U. S. imports are heavy crudes and residual fuels—both in short demand in the U. S.

Oil Industry Needs $115 Billion for Expansion . . . This amount will be spent in next 10 years to supply increasing demands of non-Communist world (See Page 69). Economists estimate that by '67 domestic demand will have risen to more than 14¼ million barrels a day, and demand in the rest of the non-Communist world will be almost as high. They expect the United States will be supplying 11 million barrels a day.

During past 10 years, '47-'56, expenditures by entire oil industry for capital investments and exploratory purposes have totaled $69 billion, about $47 billion or 67 percent in the U. S. and the remainder in other countries.

Bright Future for Natural Gas . . . U. S. natural gas reserves and finding rates are beginning to look more promising than oil. Reasons:

- Compared on Btu basis, proved reserves of natural gas amount to 140 percent of U. S. crude reserves; whereas consumption of gas is only 55 percent of total oil use.
- Apparently deeper drilling is resulting in more gas being found—and less oil. Whatever the cause, there has been an increase from 4.1 Mcf of gas per barrel of oil reserves found in '47-'49 to 6.5 Mcf per barrel in '54-'56.

However, about 80 percent of gas supply needed to meet future demand is yet to be found. Domestic consumption is expected to increase from 10.1 trillion cubic feet in '56 to 16 trillion by '65, including 1.8 trillion supplied by imports from Canada and Mexico.

Don't Let 'George' Do It

Nearly two million industry employes will soon have another golden opportunity to win new friends for oil—or to sit back and hope someone else will do the job.

That golden opportunity is Oil Progress Week, October 13 to 19.

As in previous years, the success of OPW will depend on the number of volunteers who have enough sincere interest in the future of their industry to roll up their sleeves and work. Unfortunately, as in previous years, "compulsory" company volunteers will compose most of the task force.

Many thousands more, without company urging as an incentive, will prefer to procrastinate—to say, "Let George do it." Or words to that effect. This spells apathy—a progress killer in any industry.

In fact, it has been apathy—from the top to the bottom of the organization ladder—that has allowed public opinion to stagnate to the point where a few government officials are once again free to fire dirt-laden salvos of half-truths and untruths at the economic heart of oil operations. To give but one example, an eastern newspaper recently published a series of ten feature articles viciously attacking nearly every aspect of the oil industry. The false information was far too voluminous to mention here in its entirety. Following are just three examples:

- "Until the natural gas bill last year, the oil lobby was a tremendous success. Little known to the public, it had put over such things as the 27½ percent tax cut for oil men, the tidelands grab, the sellaway of synthetic rubber plants, the suppression of synthetic oil experiments."

- "It has been a long time since the seven major oil companies have competed for markets. Nearly everything is staked out to eliminate competition."

- ". . . Oil's great drive is for the immediate and practically limitless profit; in the process the public may be damned, doomed or delighted."

With statements such as these influencing the opinion of millions of non-industry people, there can be no doubt as to the urgent need for more industry volunteers who will make an enthusiastic effort to tell the public the truth about oil's operations. Whether the industry continues to progress as a free enterprise (or be regulated to a crawl by federal control) might well hang in the balance.

There are several excellent ways to create better public understanding. However, someone, or some industry group, must take the initiative and start the action. The focal point might well be Oil Progress Week, followed by a 365-days-a-year public relations program explaining oil's side of controversial as well as non-controversial issues.

Here are some suggestions that would help immeasurably in the oil industry quest for public good will during the remaining 51 weeks:

- When controversial issues arise, the industry could present its side to the press in as complete a fashion and just as prominently as its critics. Institutional ads have worked wonders for other industries. More of these from the oil industry would be of great help.

- Maintain a more open policy toward the press when queried about company operations.

- Top management should give public relations representatives and the Oil Information Committee full support in keeping employes, stockholders and the public informed about oil's side of controversial issues and critical statements. Industry stockholders and employes alone represent a potential of nearly three million "good will" ambassadors for the oil industry.

- API could maintain a well informed staff in Washington to cooperate fully with government officials who are sincere in their efforts to consider both sides of controversial issues—to have accurate and complete statistics at their fingertips when needed—to correct erroneous criticisms of the oil industry.

The plan outlined above is by no means new. It has been discussed in varying forms by a number of industry spokesman many times in the past. Only one element needs to be added to make the plan succeed . . .

Don't let George do it. *You* do it—starting with Oil Progress Week.

New Mexico Area Offers Thick Ellenburger Pay

New Justis-Ellenburger pool in Lea County will be limited in area. But it is important because of thick pay sections and large potential production. Other Ellenburger pools in state have impressive production records.

By H. H. KING
Petroleum Consultant
Fort Worth, Texas

NEW MEXICO recently gained its most important Ellenburger oil discovery in seven years. The discovery well was Tidewater Oil Company's A. B. Coates 6-C, C NW NE Section 24-25s-37e, Justis area, Lea County. It was located on the basis of subsurface information derived from the earliest deep failures in the Lea County sector of the Permian Basin.

The new strike compensated for its proximity to structurally low dry holes by penetrating 456 feet into the Lower Ordovician zone without encountering formation water. It passed up flowing oil production from a thick zone of McKee sandstone of the Simpson series and from the Upper Drinkard (Tubb) beds.

Good Record. Ellenburger production has an impressive performance record in both the New Mexico and West Texas portions of the Permian Basin. It has been a prime target for prospecting since the 1928 discovery by the initial deep test in the Big Lake sector of West Texas. With rare exceptions, all productive Ellenburger structures also yield commercial oil or gas production from shallower horizons.

All of New Mexico's Ellenburger discoveries have been confined to the southeast portion of Lea County and within the Central Basin platform geological province. No satisfactory explanation has been advanced as to why this unbroken rule should apply. Ellenburger prospecting carried on elsewhere in Lea County and adjacent counties have encountered approximately the same Permian and pre-Permian beds, but at varying depths and thickness. The geological column of some areas is sharply abbreviated by protruding granite peaks, but these have been in the minority.

Ellenburger failures within and those outlying from the Central Basin Platform have made substantial contributions to the state's oil and gas reserves in Lea, Eddy and Chaves counties by plugging back to productive zones passed up. Majority of the productive Devonian and Pennsylvanian deep areas in the trio of counties were discovered in trying for Ellenburger production.

Deep Drilling Delayed. Deep production in southeastern New Mexico is comparatively new. Only 15 years have elapsed since the first test was drilled below the Permian, while deep production has existed only 13 years. The delay arose from the fact that Lea and Eddy counties developed shallow production faster than transportation and market outlets became available. The possibility of excessive depths and drilling costs also figured in the postponement of a try for pre-Permian production.

Numerous Ellenburger discoveries scored in West Texas after the opening of the Big Lake field gave confidence to Lea County operators that their sector of the Permian Basin afforded equal opportunities to join the ranks of deep producing areas. Interest mounted as additional reserves of sweet and high gravity crude made their appearance in West Texas. Operations were conducted on an extremely cautious basis during this period, and no single company or operator would assume the unpredictable cost of drilling a decisive deep test.

Olson-Atlantic's Langlie 1. The deadlock was broken when R. Olson Oil Company, Atlantic Refining Company and others joined in financing Lea County's first pre-Permian test. Their Langlie 1, C SE SE Section 11-25S-37E, was spudded in June, 1942. It was bottomed in Simpson (Middle Ordovician) when original contracted depth of 8500 feet was fulfilled in January, 1943. Drilling was resumed to collect on dry hole contributions calling for a test of the Ellenburger, which was encountered at 9110 feet, followed by pre-Cambrian (granite) at 9555 feet.

This initial deep test for the county was not in vain, as it was plugged back and completed as a dry gasser in April, 1944, from the 4800-foot Glorietta (Paddock) zone of the Permian, and designated as the Justis field. Geological information derived from this pre-Permian failure convinced deep-pay conscious operators that formations underlying the Permian would be somewhat similar to those encountered across the state border, and at reasonable depths.

El Paso's Ginsberg 1. In the meantime El Paso Natural Gas Company acquired deep rights to a block of wildcat leases immediately east of acreage held by the supporters of Langlie 1. Operations began in September, 1943, on the company's Ginsberg 1, SW NW Section 7-25S-38E, for a scheduled 10,000-foot test. It registered a steep dip on all formations below the Yates sand, and was without shows in quitting at 11,014 feet in Montoya (Upper Ordovician), topped at 10,710 feet. This temporarily record-depth test for the state correlates 2964 feet structurally low on the Montoya to Langlie 1, although only 1⅓ miles apart. The fault responsible for this unusual displace-

ment still rates as one of the steepest in the county.

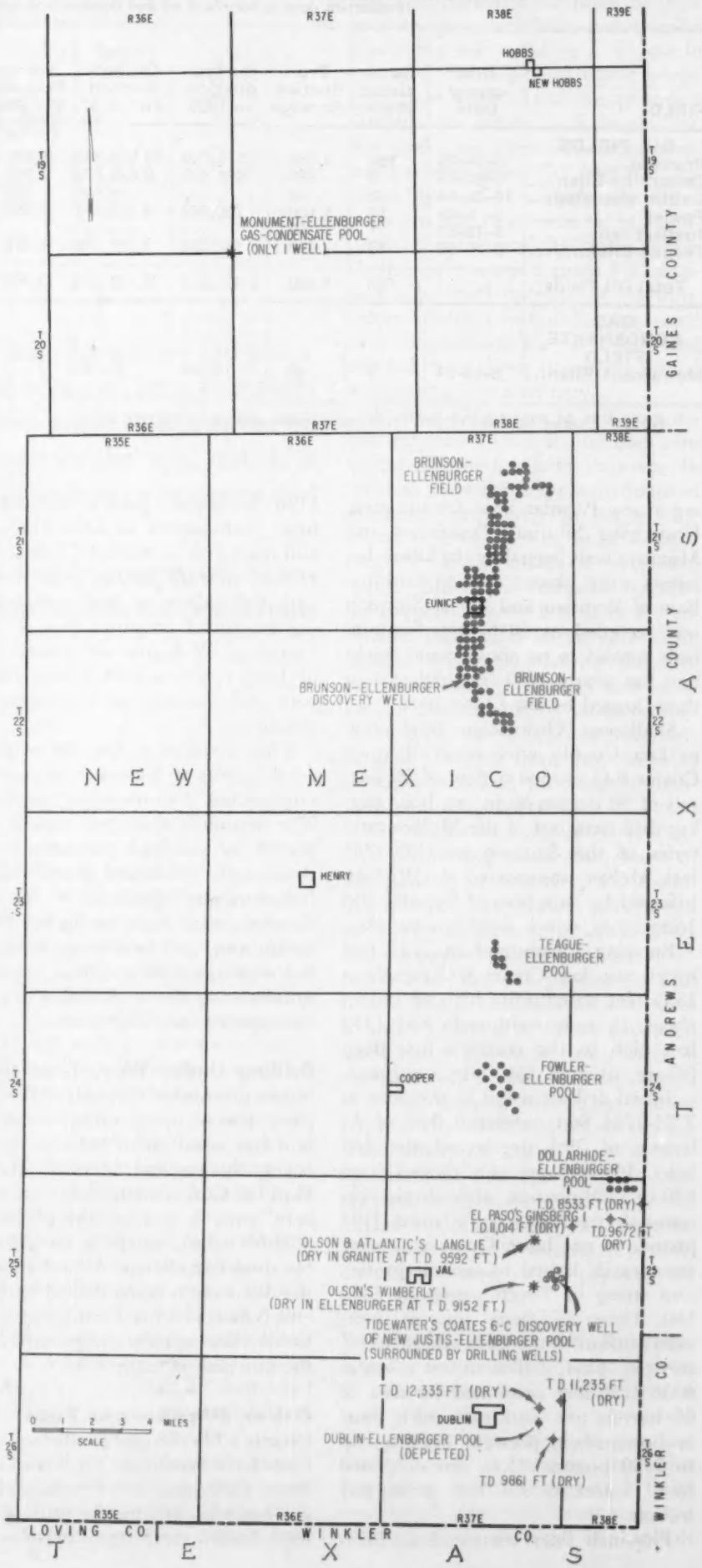
Dublin and Brunson. Prospecting shifted from this faulted area to the south about 6 miles, and in November, 1944, the small Dublin (Ellenburger) oil area was opened by Humble Oil & Refining Company. The following year Neville Penrose et al established the Brunson (Ellenburger) field as the state's most important Ordovician oil area.

Olson's Wimberly 1. Encouraged by these deep strikes, R. Olson Oil Company induced 11 companies and operators to join in financing a new prospect 1¾ miles south of the deep failure on the Langlie tract. Their Wimberly 1, C SE NE Section 23-25S-37E, duplicated its record by checking structurally about level on all pre-Permian formations. Depth contract was fulfilled at 9152 feet in Ellenburger, topped at 9112 feet, or 34 feet structurally low. Well was plugged back and completed as a gasser in the 4700-foot zone in December, 1947.

The geological challenge offered by the nearly uniform structural position of the failures sponsored by R. Olson et al and the steep dip recorded by Ginsberg 1 was allowed to remain dormant for about 10 years. In the meantime the intermediate area was canvassed repeatedly to acquire leases.

Tidewater's Discovery. Tidewater Oil Company, owner of a 400-acre lease, largest interest held by any company within the favored area outlined by the early deep failures, took the initiative in scheduling A. B. Coates 6-C, C NW NE Section 24-25S-37E, as an Ellenburger prospect. Structure buildup became evident upon entering the Tubb zone at 5620 feet. Flow of 25 barrels oil per hour was recorded in making drill-stem test of the lower section at 5960-6000 feet, open-

Ellenburger Pools of Southeastern New Mexico



Justis-Ellenburger (southeast corner of map) is newest of southeast New Mexico's Ellenburger pools, all of which are shown here. (This map shows only Ellenburger pools although the area shown is productive extensively also from shallower formations.) The Justis-Ellenburger well, Tidewater Oil Company's A. B. Coates 6-C, Lea County, is surrounded by other wells now drilling. The new pool will be limited in area. This is indicated by several adjacent deep dry holes. However, it is an important discovery because of large potential production. The discovery well has an exceptionally thick section of Ellenburger pay. It also yielded oil from several shallower pay formations.

Productive Ellenburger Areas in New Mexico

(Production data in barrels of oil and thousands of cubic feet of gas)

FIELD	Discovery Date	Completed Wells	Productive Acreage	Oil Production in 1956	Total Oil Production To 1-1-57	Average Recovery Per Acre	Average Recovery Per Well	Gas Production in 1956	Total Gas Production To 1-1-57	Average Gas Production Per Well
OIL FIELDS										
Brunson	9-14-45	154	6,160	1,176,786	23,966,369	3,891	155,626	9,086,761	73,275,243	475,813
Dollarhide-Ellen	5-24-51	8	320	401,370	2,334,370	7,295	291,786	109,795	824,884	103,110
Dublin (depleted)	11-20-44	1	40	.....	39,460	986	39,460	.....	162,680	162,680
Fowler	5- 6-49	14	1,120	720,962	4,030,182	3,598	287,870	578,229	3,250,359	232,168
Justis-Ellen	6-10-57	1	40	.....	.....	....	.....	.....	.....	.....
Teague-Ellen	2-19-50	10	400	132,093	1,751,195	4,378	175,119	162,206	1,892,527	189,252
Total Oil Fields	.....	188	8,080	2,431,211	32,121,576	3,995	171,773	9,936,991	79,405,703	424,629
GAS CONDENSATE FIELD										
Monument-Ellen	8-13-54	1	40	10,942	24,025	....	.....	494,751	1,076,009	1,076,009

Note: Fowler field developed on 80-acre units; others on 40-acre units.

ing a new Permian zone for the area. Underlying Silurian, Fusselman and Montoya beds logged by the Olson Interests were absent due to faulting. Base of Permian and top of Simpson was recorded at 6816 feet. Simpson beds proved to be about equal thickness but nearly 1300 feet higher than those logged by the Olson tests.

Shallowest Ordovician production in Lea County was assured when Coates 6-C yielded a flow of 52 barrels of 40 degree oil in one hour during drill-stem test of the McKee sand series of the Simpson at 7173-7383 feet. McKee was entered at 7192 feet, followed by thin beds of Connell and Joins zones, which were not tested.

Entering Ellenburger at 7721 feet by electric log, Coates 6-C correlates 1383 feet structurally high to failure about ⅞ mile southwest, and 1349 feet high to the county's first deep failure, situated 1⅜ miles northwest.

Initial drill-stem test of this zone at 7734-7784 feet registered flow of 41 barrels of 39.1 degree oil the first hour. Flowing pressure ranged from 820 to 1580 pounds, while shutin bottom-hole pressure registered 3195 pounds in one hour. Operations were temporarily halted to cement protection string of 7-inch casing at 7893 feet. Three additional tests at intervals confirmed the presence of effective pay. Final drill-stem test taken at 8056-8171 feet accounted for flow of 65 barrels per hour rate, with shutin bottom-hole pressure building up to 3330 pounds. Hole was deepened to 8177 feet, or 456 feet in the pay section.

Five-inch liner cemented at 7855-8166 feet made it possible to complete from perforations at 8115-8145 feet and open hole at 8166-8177 feet. This 41-foot over-all section was washed with 650 gallons of mud acid, resulting in official potential flow of 1006 barrels of 42 degree oil; gas-oil ratio of 1202/1, via ½-inch tubing choke, with 515 pounds back pressure on tubing.

This discovery has the required combination of factors to become an outstanding Ellenburger producer. The unusually thick pay zone is supported by normal pressures for its depth, plus a balanced gas-oil ratio.

Preliminary appraisal of the productive area reveals that its two Ordovician zones will be extremely narrow, but with adequate length in a general northwest-southeast direction to cover between 400 and 600 acres.

Drilling Under Way. Development began promptly. Tidewater Oil Company has a south offset underway, and has scheduled a twin to the discovery to complete from the McKee. Gulf Oil Corporation, owner of a 320-acre lease, is nearing completion on a north offset, which is slated to try for dual completion. A west offset to the discovery is being drilled by Western Natural Gas Company et al. Other close-in lease owners will await the outcome of these tests.

Other Ellenburger Pools. Lea County's Ellenburger producing structures have accounted for from one to three additional pre-Permian oil, or gas horizons, besides the usual run of semi-shallow and deep Permian oil, or gas pays. Ellenburger production is presently restricted to seven adjacent townships, and in each instance underlying established shallow Permian fields.

Decisive exploratory tests elsewhere in the county, and beyond into adjacent Eddy, Chaves and Roosevelt counties proved disappointing for Ellenburger production. However, numerous Devonian, Pennsylvanian and deep Permian oil and gas-condensate fields have been developed in these counties by plugging back deep failures. Prospectors in these counties have shown a tendency in recent years to restrict their depth penetration to Pennsylvanian and Devonian beds, due to costs involved in reaching the Ordovician series.

Pools Small in Area. Based on some 15 years experience, it appears that Lea County's Ellenburger production is destined to be restricted to comparatively small areas.

Brunson Field. One exception is the Brunson field, opened in September, 1945, by Neville Penrose et al's Penrose-Federal 1 as the initial deep test for the Penrose-Skelly shallow oil field. This Ellenburger structure has been drilled out along a wavering north-south trend for 9½ miles, with a maximum width of 1½ miles.

Developed on a 40-acre spacing pattern, it accounted for a maximum of 165 wells on 6160 productive acres. Oil output in 1956 totaled 1,176,786 barrels, for a cumulative total of 23,966,369 barrels. This is an average of 155,626 barrels per contributing well,

Continued on Page 61

How We Licked Oil Cost Accounting

The author describes how Monterey Oil Company's cost system was built "from scratch" by a relatively small accounting force in a medium sized independent oil producing company. The system passes the acid test: it is being used, by superintendents, petroleum engineers and top management.

Different periods are readily compared. Management can tell at a glance when significant variations from normal occur.

By MARSHALL E. DUNN
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COST ACCOUNTING in the petroleum industry has several peculiarities setting it apart from cost accounting in the manufacturing industry. When the accounting department of Monterey Oil Company undertook in 1953 to develop costs for management, these peculiarities made the job more difficult—and more interesting.

Peculiarities of oil production accounting. First, the accounting is for an extractive product. The initial cost of finding the oil is high and is difficult to estimate. When found, the depletable source, or rather many depletable sources, and costs of extraction may vary greatly from property to property and during the life of one property.

Second, a multiplicity of properties are being dealt with rather than a few plants and/or a few products. Management wants to know the costs and statistics for each oil or gas lease, sometimes for each well. For example, Monterey has an interest in about 200 producing properties, with several hundred wells scattered throughout the Far West, Mid-Continent and Rocky Mountain areas. In addition to geographical differences, production problems vary on different properties. As an instance in point, gas wells require relatively small lifting costs, and flowing oil wells a little more, but it usually costs considerably more to lift the fluid in a pumping oil well, due to the initial and continuing costs of installing and operating the required pumping unit and power plant, together with perhaps a mile or more of rods in the hole.

Examples along this line could be multiplied endlessly. An extreme case of high cost operation was a field in Monterey County, California, formerly operated by Monterey Oil Company. The oil from this field was of such high viscosity that, if a half-filled jar of the oil at room temperature was turned upside down, the oil would remain at the top. To transport this oil from wells to tanks, it had to be heated with steam lines inside each flow line. The company which purchased this oil at the tank batteries and transported it 35 miles by pipe line to tidewater, built two parallel pipe lines, one to bring a diluent to mix with the heavy oil which would then flow and could be pumped through the second and larger line. Needless to say, these difficulties raised costs considerably. To cite still another instance, an entirely new set of problems and costs were faced in offshore development at Seal Beach, Calif. There is much room for imagination to dwell on some of the difficulties inherent in building an island drill site, drilling for oil a mile and one-half from shore, producing this oil and getting it to a refinery.

A third difference in oil cost accounting arises from the oil man's inherent affinity for joint ventures. In order to share the risk, obtain financial assistance, or merely to get a little moral support, two or more companies frequently divide a promising "play." Since one company operates the property for the benefit of the coowners, there must be an agreement, implied or actual, covering the allocation of indirect charges and overhead. Since these differ from venture to venture, the allocations will vary in many respects from the allocation formulas followed for costs of nonjoint venture properties.

The final pecularity of oil production accounting arises from some of the methods of financing. For example, assume a corporation purchases a producing oil lease subject to a $100,000 oil payment to be paid out of 75 percent of the oil produced. This means that the corporation is entitled to only 25 percent of the oil produced until the $100,000 is paid. Often a company will record only one-fourth of the oil sales as income, but it must pay the cost of lifting all of the oil. Thus any "per barrel" net income figures on the cost reports for this lease are not comparable with properties having no outstanding oil payments and cannot even be compared with its own income after the oil payment has been satisfied.

Developing the Cost System. Keeping in mind the unusual features of oil production accounting, let us now trace the development of the cost system. According to one authority, cost accounting has four functions: (1) determination and analysis of costs and income so that comparisons by divisions and periods

of time can be made to evaluate efficiency, (2) accumulation and utilization of cost data for the purpose of controlling costs, (3) proper matching of costs with revenues, and (4) special cost studies and investigations.[1]

Within the framework of these functions, what information did management want to know that a good cost system could supply? Management wanted to compare income and costs of each producing property (remember, Monterey had 200 properties) by periods and with similar properties in the same or different oil fields. It wanted costs divided into controllable and noncontrollable categories to assist production superintendents and managements to keep costs down. It needed statistics on the number of wells and the barrels of oil produced and sold, to give it common yardsticks. Management wanted costs and comparisons of the various service units (well pulling, pumping, transportation, etc.) to determine relative efficiency in different areas and over periods of time. In this regard, management also was alert to comparisons of our costs with the charges by outside contractors for similar work.

With these desires in mind, the work began. First, the chart of accounts was revised to properly segregate expenses into what might loosely be called cost centers. Table 1 is a simplified schedule of a portion of the chart of accounts. It will be noted that the first digit "9" always indicates expense. The "90" series reflects "direct operating expense." In this series are recorded all direct charges to producing properties and allocations from the service accounts, miscellaneous expense accounts, etc. Each producing property has its own "90" series, which means that this series is multiplied by 200 in our company. Accounts "92" through "96" are all "service accounts" and are broken down by cost centers based on geographical and physical division of the work involved. For example, Monterey has a pumping string in Field A and two in Field B, so a pumping service account was set up for each of these three strings and for each additional string throughout the company. As another example, the company maintains three garages in California, so three cost centers were established for the mechanics' service accounts in that state and others as needed elsewhere. So, step by step, it was determined and established what were the normal cost centers for each account. The third digit in the chart is semi-functional and, with minor variations and exceptions, stands for the same type of expense wherever used.

To round out this explanation of the chart of accounts, it should be added that "97" is the administrative expense series, "98" details exploration expense, and "99" is used for "other expenses and charges"—such things as taxes, depreciation and depletion, employe benefits, interest expense, abandonments, casualty losses, etc. Of these, taxes, employe benefits, depreciation and depletion are generally allocated to the ultimate accounts affected, leaving little or no balance in these accounts.

All costs accumulated in the service accounts are eventually cleared to the "90" account (with minor portions going to administrative or various asset accounts). This leaves on our books 200 lease operating expense accounts, plus administrative and exploration expense and some of the "other expenses and charges" which have just been enumerated.

The Cost System in Operation. To study this system in operation, turn first to the service accounts. Each is a miniature business of its own (nonprofit, or course), in which are accumulated all costs of running that business. This part is easy, but now to figure out how to charge the customer. Perhaps a mechanic works three hours on a pumping unit on XYZ lease and one hour on a company administrative car. How to distribute the cost? The mechanics' account was purposely chosen as an example, for it is fairly easy to allocate. On the basis of a cost study, an hourly rate (say $3) is determined which perhaps will recover all the costs of operating the garage, including overhead, depreciation of tools, etc., and on this basis we charge XYZ lease $9 and the administrative transportation account $3. In effect, an attempt is made to distrib-

About the Author

MARSHALL E. DUNN has been associated with the oil industry since 1940, when he became chief accountant with the Kepley Production Company in Corpus Christi, Texas. Two years later he joined Southern Minerals Corporation, Corpus Christi, as assistant auditor. He moved to Long Beach, California, in 1948, and subsequently was associated with Jergins Oil Company and its successor, Monterey Oil Company, having become controller in 1951. In 1955 he became a partner in Bursdall, Dunn & Company, certified public accountants, Compton, California. Dunn now is operating alone as a CPA at Long Beach, California. He is executive chairman of publicity and promotion for the international systems meeting of the Systems and Procedures Associations of America, to be held in Los Angeles in October, 1957.

TABLE 1—Partial Chart of Accounts
(Illustrating service accounts used and functional account number series)

	Direct Operating Expense	General Field Expense	Pumping Service Expense	Well Pulling Service	Mechanics Service	Transportation Service
Payroll labor or salaries	900	920	930	940	950	960
Operating supplies	901	921	931	941	951	961
Utilities and fuel	902	922	....	942	952	....
Transportation and traveling expense	903	923	933	943	953	....
Repairs and maintenance	904	924	....	944	954	964
Insurance	905	925	935	945	955	965
Pumping services	906	....	....	....	....	....
Gas, oil, butane and diesel fuel	....	....	....	....	....	966
Well pulling services	907	....	....	....	....	....
Field office expense	....	927	....	....	....	....
Tires and tubes	....	....	....	....	....	967
Allocated charges	908	928	938	948	958	968
Dehydration	9080	....	....	....	....	....
General field expense	9081	....	....	....	....	....
Taxes	9082	9282	9382	9482	9582	9682
Depletion and depreciation	9083	9283	....	9483	9583	9683
Other	909	929	939	949	959	969
Credit for charges to others	909C	929C	939C	949C	959C	969C
Credit for joint operators' share	909J	....	....	....	....	....
Distribution credits	....	929D	939D	949D	959D	969D

Mechanics Service District: Harbor

6/30/53	Quarter Ended	Fiscal Year to Date	6/30/53
	Expense		
	Controllable		
$ 17 069	Payroll Labor	950	$ 94 798
813	Supplies & Small Tools	951	614
159	Utilities and Fuel	952	318
980	Transportation	953	2 960
150	Repairs and Maintenance	954	300
1 375	Insurance	955	2 750
	Other Mechanics Expense	959	
20 046	Total Controllable Expense		41 680
3.11	Per Chargeable Hour	H	3.25
	Other Expense		
209	Taxes	9582	508
273	Depreciation	9583	546
20 528	Total Mechanics Expense	95	42 737
3.18	Per Chargeable Hour	H	3.34
	Prior Years (over) Under Distributed Balance	959	746
20 528	Net Expense to be Distributed		43 483
(21 295)	Distribution Credits	959D	(42 590)
$ (767)	Expense (Over) Under Distributed		$ 890
	Labor Hours		
6 453	Chargeable	H	12 806
112	Non-chargeable		224
6 565	Total Labor Hours		13 030
$ 3.30	Current Rate Per Chargeable Hour		$ 3.30

FIGURE 1

Transportation Service District: Harbor

6/30/53	Quarter Ended	Fiscal Year to Date	6/30/53
	Expense		
	Controllable		
$ 1 932	Payroll Labor (Truck Drivers)	9600	$ 3 884
119	Operating Supplies	9601	238
3 173	Repairs and Maintenance	9604	6 346
514	Insurance	9605	1 030
1 774	Gas, Oil and Butane	9606	3 541
403	Tires and Tubes	9607	917
	Other Automotive Expense	9609	
7 915	Total Controllable Expense		15 963
	Other Expense		
606	Taxes and Licenses	96082	1 222
2 444	Depreciation	96083	4 193
10 965	Total Transportation Expense		22 013
	Prior Years (Over) Under Distributed Balance	9609P	420
10 965	Net Expense to be Distributed	960	22 503
(10 947)	Distribution Credits	9609D	(21 859)
$ 18	Expense (Over) Under Distributed		$ 644

Hours	Distribution	Current Rate	Hours
	Labor Hours		
792	Chargeable	$ 2.55	1 820
	Non-chargeable		
	Equipment		
	Hourly Rate		
390	D.D. Hoist	1.50	880
96	S.D. Hoist	1.30	92
1 212	Tool Truck	1.25	3 414
	Trucks - Light		
47	Trucks - Medium	2.90	47
520	Trucks - Heavy	3.53	719
57	Semi-Truck-16 Ton	5.11	105
	Trailer		
	Dolly		
266	Vacuum Truck	3.71	442
Miles	Mileage Rate		Miles
	Trucks - Light	.10	
1 772			2 894

FIGURE 2

ute the accumulated costs to the ultimate "consumer" of the services in the most equitable method we can determine (within the limits of practicability).

In this particular service account, the details on the mechanics' time cards furnish the necessary statistics to allocate the cost of operating the garage. In the case of pumping strings, the work done for the benefit of a given lease follows a fairly fixed pattern, so the number of producing wells served by the string, perhaps weighted somewhat by barrels of oil shipped from each lease, may prove to be a proper allocation yardstick. Pumping string expense is cleared completely each period on a pro-rata basis rather than allocated on the fixed rate basis used for mechanics and several other service accounts. Each problem must be studied separately to determine the best formula and periodic review is necessary to keep allocation theory in harmony with operating reality. Operations do not yet justify tabulating equipment, but payrolls are prepared and the labor distributed on such equipment by a service bureau.

Reporting to management. When the costs are properly distributed, a way must be found to convey their story to management. This is done by periodic reports. Exhibits 2, 3 and 4 show three hypothetical cost sheets—two of service accounts and one a lease cost sheet. A look at the Mechanics Service Costs, Figure 1, will show seven account classifications, followed by a "total controllable expense" amount. These items are the ones of most interest to the superintendents, for something can be done about them. The charges reach this service account from the voucher register, company payrolls, sundry journal entries, and from clearing journals of other service accounts. For example, sub-account 953, transportation, in the mechanics service account, includes charges from the transportation service account covering mileage driven by the mechanics in company-owned equipment. The superintendent is not so interested in the next two items, taxes and depreciation, because they are, for the most part, beyond his control. It might be noted that important statistical information—the cost per chargeable labor hour—is

FIELD: Harbor LEASE: Jones

6/30/53 ← QUARTER ENDED				FISCAL YEAR TO DATE → 6/30/53		
3		Number of Productive Wells:	W		3	
		Production - Barrels (or MCF ☐)				
2	077	100%	P		4	927
1	384	Company Interest Before Royalty	B		3	285
1	170	Company Interest After Royalty	A		2	776
		Shipments - Barrels (or MCF ☐)				
1	260	Company Interest After Royalty	S		2	680
		Income (Company Interest After Royalty)				
$ 2	758	Sales of Oil		$	5	428
		Sales of Gas and Gasoline				
2	758	**Gross Lease Income**	80		5	428
2.189		Per Company Interest Barrel Shipped	S		2.025	
		Lease Expense				
		Controllable				
	22	Payroll Labor (Except Service Accounts)	900			194
	19	Operating Supplies	901			51
	55	Utilities and Fuel	902			277
		Transportation	903			11
	639	Repairs and Maintenance	904		1	899
	2	Insurance	905			5
	450	Pumping Service	906		1	071
	249	Wellpulling Service	907		1	233
	117	Dehydration	9080			117
	682	General Field Expense	9081		1	047
	2	Other Lease Expense	909			3
2	281	Total Controllable Lease Expense			5	908
1.091		Per 100% Barrel Produced	P		1.199	
253		Per Well Per Month	W		281	
		Other Costs				
	200	Taxes (100% Working Interest)	9082			430
	560	Depletion and Depreciation (Net Co. Int.)	9083		1	328
3	041	Total Lease Expense			7	666
1	014	Deduct: Charges to Others	909C]		2	555
2	027	**Net Lease Expense**			5	111
		Administrative Expense (Total Sheet Only)				
2	027	**Total Expense**	90		5	111
		Per Company Interest Barrel				
1.464		Produced Before Royalty	B		1.556	
$	731	**Net Income - Producing Operations**		$		317
.580		Per Company Interest Barrel Shipped	S		1.183	
		Co. Int. (Excl. Oil Payment of ____ % of 100%)				
		Before Royalty 66.666 % of 100%	B			
		After Royalty 56.331 % of 100%	A or S			

FIGURE 3

emphasized in boxes below the various expense totals.

Since the company is striving to distribute the service account costs in such a way as to end up with a zero balance, next added in is the undistributed balance, if any, from the previous year. The resulting total is the cost of operating the garage and is the amount to be cleared to the various leases or other accounts served by the mechanics. This is done, as was explained earlier, by means of a clearing journal based on information from the mechanics' time cards, with the resulting credit posted to a separate subaccount. From the statistics at the bottom of the cost sheet, it can be seen that the current clearing rate for this garage is $3.30 per labor hour. It is also easy to see that this rate is doing a good job of reaching the "theoretical zero."

The Transportation Service Costs, Figure 2, is more involved and requires several clearing rates rather than one. The equipment rates were initially predicated on the basis of 75 percent of comparable commercial rates as the best available yardstick. The 25 percent was deducted in order to eliminate the commercial operator's estimated profit. This practice is, incidentally, in line with many joint venture agreements. Monthly mileage reports on our automobiles and daily time cards on our trucks furnish the raw material for allocating the costs to the ultimate consumer of the transportation service.

Let us turn now from the service accounts to the goal of the system, a miniature profit and loss statement for each producing property. The illustration in Figure 3 is for three fictional wells which have been drilled on a lease from a Mr. Jones in the Harbor field. At the bottom of the sheet, it is disclosed that we own two-thirds of the working interest. That means we have one or more co-owners in this lease, i.e., a joint venture. After paying Mr. Jones his royalty and settling with our co-owners, we retain 56 percent of the total oil produced. At the top of the page above the double line, these percentages are used to reduce the total oil produced or sold to our own share. Between the double lines we have the actual statement, transcribed directly to a ditto master from the ledger cards after the quarterly trial balance.

Once more it can be commented that the operating division is most interested in controllable expense. Watching these and the significant statistics, division management can pounce on a weak point disclosed or perhaps institute a deeper study into the causes of a high cost item. Gross and net income are, of course, scrutinized to see whether or not the well or wells require remedial work or perhaps should be abandoned. The latter is never done until a survey in-

dicates a cash savings from this action. For example, depletion and depreciation costs represent return of capital already spent and very little of this is salvagable if a well is abandoned.

It should be pointed out that all operating expenses on the Jones lease are 100 percent costs before deducting the co-owner's shares. We thus have a common ground for cost comparison, regardless of our own percentage of interest in the lease. The co-owners' share is deducted on the line "deduct: charges to others," leaving our own portion in "net lease expense." Since only our portion of oil or gas sales is included as "gross lease income," the final total, "net income-producing operations" also reflects the company's net profit from the property. Incidentally, it looks as if the Jones lease is not making much money and it may be in line for a more detailed cost study to determine the advisability of abandonment.

Management Reads and Acts. The material which has been presented gives a fair idea of how the cost system works and how the information it develops is reported to management. No cost system is worth its cost in time and effort unless it presents the finished product to management in a way which permits an easy interpretation of the stories it can tell. One of the keys to the success of this particular system lies in the ready comparison of different periods, made possible by the shingling of the cost statements in a multiple ring binder. This permits a ready comparison with past periods and enables management to tell at a glance when significant variations from normal occur.

This article has described a cost system built "from scratch" by a relatively small accounting force in a medium sized "independent" oil producing company. It is not perfect. It is constantly being modified to improve the end result or to correct inequities in its application. However, the results are being used by the superintendents, the petroleum engineers and by top management. That is the acid test of any cost system.

ACKNOWLEDGMENT

From *N.A.C.A. Bulletin*, July 1955, pp. 1493-1500, National Association of Cost Accountants.

REFERENCE

[1] Blocker, John G., Essentials of Cost Accounting, McGraw Hill (1950).

New Mexico Area Offers Thick Ellenburger Pay

Continued from Page 52

and an average of 3891 barrels per productive acre.

The field's discovery accounted for 314,733 barrels, although it is situated only two locations inside the producing contour to the east and west. Production in this field has been greatly restricted as a conservation measure by penalizing each well that produces in excess of 2000 feet of casinghead gas per barrel of oil. The apex of the structure carries a thick section of gas-condensate above the oil column.

Fowler (Ellenburger) field, opened in 1949 by Pan American Petroleum Corporation (Stanolind), has produced 4,030,182 barrels of oil from 14 completions. Developed on an 80-acre spacing pattern instead of the customary 40-acre unit, it has averaged 3598 barrels per developed acre. The contributing wells have an average of 287,870 barrels each. This discovery boosted its total to 583,217 barrels of oil at the close of 1956, while another completion on the same tract has also exceeded 500,000 barrels in output.

Teague-Ellenburger Pool. The nearby Teague (Ellenburger) field has an average yield of 175,119 barrels from 10 contributing wells on 400 productive acres. Recovery per acre averaged 4378 barrels as of January 1, 1957. Gulf Oil Corporation's discovery has accounted for 304,102 barrels of oil.

Dollarhide Area. Performance leader among the Ellenburger fields is the Dollarhide area, which has three pre-Permian and two shallow Permian oil zones. Development of the Ellenburger was concluded after completing eight wells, which have averaged 291,796 barrels per well, and 7295 barrels per productive acre. Skelly Oil Company's discovery has produced 379,004 barrels of oil during its 5½ years of continuous flow. This Ellenburger area is not related to a more expansive producing sector from the same zone on the Texas side of the multi-pay structure.

Hobbs field, first major oil strike for the state, was rated as an outstanding prospect for pre-Permian production, due to its size and type of Permian structure. A decisive deep test drilled near the apex of the San Andres structure has partially eliminated this 10,600-acre field for commercial production below the discovery zone. The pre-Permian beds were unusually thin, as the Montoya (Upper Ordovician) was entered at 7880 feet. Nominal beds of detrital and granite wash were followed by granite that was drilled to 8160 feet. Operators have not ruled out the possibility of a near normal section of pre-Permian beds being present in another sector when deep explorations are revived.

Gas Production. Revenue from the sale of casinghead gas produced by Ellenburger wells figures prominently in amortizing development and operating costs of the deep wells. Discoveries have been within convenient reach of the gas gathering facilities of the El Paso Natural Gas Company and other trunk line outlets.

The Ellenburger gas-condensate zone overlying the oil formation in the Brunson field constitutes a substantial portion of its reserves. Ratio of gas to oil has experienced a steady rise under the impact of an expanding gas cap each year, thereby necessitating progressive cuts in assigned daily oil allowables, currently 89 barrels daily maximum. About 75 percent of the active wells exceed the permitted maximum ratio of 2000 feet of gas per barrel of oil and are penalized in allowable accordingly.

Brunson field's Ellenburger wells produced 9,086,761,000 feet of gas in 1956 for a cumulative total of 73,275,-243,000 feet. This is an average of 475,813,000 feet of gas per well, including those depleted, inactive, else plugged back to Permian pays.

The 14 widely spaced completions in the Fowler (Ellenburger) field have accounted for an average of 232,-168,000 feet of gas per well. The Teague and Dollarhide deep-pay areas have lagged in gas output in averaging 189,252,000 feet and 103,110,000 feet of gas per contributing well, respectively.

ACKNOWLEDGMENT

Credit is hereby given to the Lea County Operators' Committee, Glenn Staley, chairman, as the source of oil and gas production data presented in this article.

How to Ruin a Staff Meeting

Check these 25 "rules to ruin" for meeting leaders. Some may apply to you.

By J. DAMON QUINTON
Consulting Psychologist
Houston

THERE ARE many ways to make a staff meeting unsuccessful. Listed below are a few sure-fire "rules to ruin" for the meeting leader.

You may not have been as extreme in your actions as these indicate, but there may be some rules here that elicit guilt feelings. If so, your comment may be, "Well, I'm not *that* thoughtless, but . . ." So—check the ones that you have guilt feelings about and seek to correct *your* "rules to ruin."

1. Send Notices Two Months in Advance. This will allow the notice to be misplaced and forgotten. At starting time on the day of the conference, your secretary will have to call about half the participants. This will use up at least one hour of your time. Those who came on time get bored and restless. Latecomers are confused and apologetic.

2. Do Not Check Meeting Room. Especially if the meeting is to be held at a new location. More than likely the place will be uncomfortable, unpleasant and disagreeable. This will put a damper on discussion. You, the leader, will be under a strain. Perspiring, wiggling participants will add to your discomfort. A poor meeting place will convince the participants that the company lacks interest in the conference.

3. Be Late for Meeting. And have the only key to the conference room. Let the men stand around in the hall. That helps to ruin the conference. They will be grumbling, disgusted and in no mood to hold an enlightening discussion.

4. Let Group Arrange Own Chairs. This will guarantee a poorly arranged and scattered group. Most of the members will be lined up against the back wall. Friends will sit together in huddles and talk in loud stage whispers throughout the conference. That large, forbidding space between the leader and the participants will add to the downfall of the meeting.

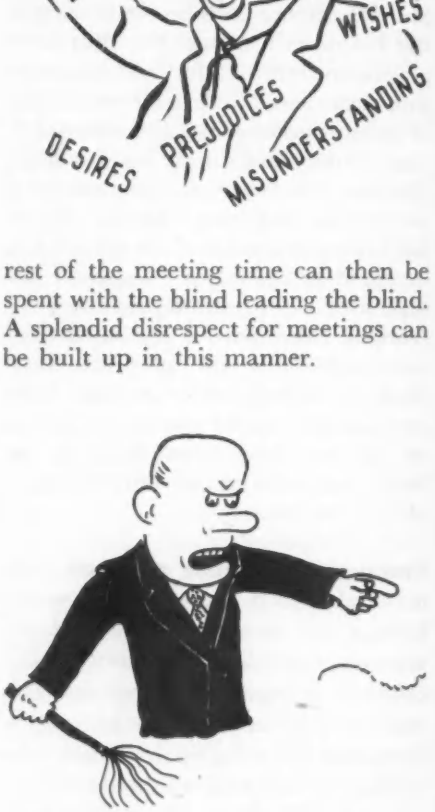
5. Do Not Control Temperature. You know that 68 degrees is the best temperature to have at a conference but darned if you're going to spend all your valuable time setting thermostats. Besides, if the temperature is high the men become sluggish and won't ask those embarrassing questions. "Let sleeping dogs lie" is a good motto here.

6. Don't Prepare Yourself. It is well known that most company meetings fail because the leader does not prepare himself. Don't bring prepared questions. Just "throw the meeting open." Everyone will just sit there in the awkward silence. Maybe everyone can get up and go fishing because your conference has had it, and you're off to a terrible start.

7. Be Ignorant of Topic. In this way the leader can illustrate to the group that he can consider no subjects that are not specifically covered in the leader's guide. To help this "rule to ruin" along, the leader can bluff his way through embarrassing questions. The result? Why, the leader will lose all the prestige he ever had. Not only will *this* meeting be ruined but future ones as well.

8. Introduce Subject in Long, Stilted and Biased Manner. By the time you finish this lecture type of introduction the participants will not understand the topic and will not know the problem to be solved. The

rest of the meeting time can then be spent with the blind leading the blind. A splendid disrespect for meetings can be built up in this manner.



9. Dominate the Group. The more the leader talks the less the participants talk. The members will begin to resent the leader's implication that he is the only one there with enough brains and experience to solve the problems. They feel useless and soon the session has turned into a "one man's opinion" affair.

10. Use Formal Language. This will create a stuffy atmosphere and dampen discussion. The participants will soon feel that the leader is "stuck up."

11. Alternative: Establish Informality Quickly. This can be accomplished by using profanity and telling dirty stories. You will find that you have succeeded in losing the respect of the group. Your meeting is now on the way to a howling failure.

12. Let a Few Members "Hog" Discussion. The best thinking of the group is not brought forth. If you do try to break this monopoly, do it di-

rectly. Administer a public rebuke. This will make the "hoggers" antagonistic or induce them to refrain from talking altogether. These people can create more confusion accidentally than you can intentionally. They are key people on your road to ruin. Encourage them.

13. Encourage Useless Debate. Guarantees to result in a "yes, it is" and "no, it isn't" discussion that uses up all the conference time and, more important, leads nowhere. Whatever you do, try to encourage the discussion so that the participants become highly emotional. The best planned company meeting can be broken up and ruined because everyone else learns only the prejudices and dogmatic ideas of the combatants.

14. Don't Draw Out the Reticent Member. If you do draw him out you may find that he has a great many fine ideas and can express them well. But this is apt to lead the meeting into productive channels. Soon the participants will be full of useful ideas for solving problems, making new products, etc. You will *never* ruin a conference in this manner. So watch your step.

15. Have Phone Calls of Members Transferred to the Conference Room. Best way known to ruin a meeting. Keeps party called from participating and interrupts the thoughts of everyone else. Personal calls from the conference leader's wife, or children, to pick up groceries show just how determined *he* is to ruin the meeting. Other members will develop an outstanding dislike for future conferences.

16. Answer All Questions Directed at You. Inject personal opinion heavily in discussions and answer all questions immediately. Referring the question to the group or redirecting the question to the questioner will only result in the group, collectively and as individuals, doing their own thinking. And don't label your opinions as such. State them as accurate facts. There is no need for a spirit of impartiality to prevail. If a group member wants to debate with you on a controversial point, do so. You can turn a meeting into a lively, stimulating cat and dog fight.

17. Be Blunt With Trouble Makers. To get a grouchy and negative member in a terrible mood, just tell him he's wrong when he blurts out his half-baked ideas. He will then become highly emotional and stubbornly defend all his remarks. A splendid feeling of resentment toward the leader develops. Don't let this trick you into using tact. Tactfulness is the prime requisite for a *successful* meeting. Let's have none of *that!*

18. Use No Humor. A good laugh aids a meeting. An amusing story interferes with heated arguments. A laugh tends to break down tension and relaxes the group. Easy discussion is encouraged. Great care must be used here or, before you know it, your conference is a success.

19. Ask Questions That Can Be Answered Only With "Yes" Or "No." This does not permit time consuming detailed answers. It will scotch all opportunity for participants to discuss the topic further by question, amplification, or disagreement. If you can't possibly ask the question in such a way as to elicit a "yes" or "no," then by all means use the leading question. This will put an end to bothersome thinking. The conference will develop into a "yes" and "no" social gathering, or into a debating society between the leader and his allies and the remaining participants.

20. Don't Use Charts or Blackboard. Charts tend to direct thinking. Besides, things that we see make a lasting impression on our minds. The participants are apt to remember vital points. Arranging ideas logically on a chart might stimulate the conferees to greater thinking. The horrible result? A lessening of the chance of forming wrong conclusions and forgetting important facts. In addition, the conferee will develop a sense of importance by seeing his contributions appear before the group.

21. Don't Become Familiar With Prepared Charts. Be surprised! Don't take undue advantage of the group by studying the charts beforehand. Just assume that everyone, including yourself, should understand each chart no matter how complicated it might appear. Just figure out what to say as you go along. To

add to the confusion and ruin, keep these techniques in mind: (a) Let shadows or glare engulf the chart, (b) use any old scribble in preparing the words, (c) put a half-day's information on one chart, (d) stand in front of the charts when you use them, and (e) use long and unnecessary words.

22. Don't Use other Visual Aids. Such aids as movies, film-strips, flip charts, etc., will increase interest as much as 40 percent, make a subject 25 percent more understandable, reduce learning time by 25 percent and add to the amount of learning that will be remembered for a year approximately 36 percent. It is well known that people like these visual aids. No use pampering them. If you *have* to use a film get one that does not present ideas or principles for consideration. On the contrary, get one that is designed on the "here's how to do it" or "we know it all" basis. To keep the leadership work off your back, never use the film as an aid. Let it do the

entire teaching job. While the lights are out you can get in 40 winks.

23. Never Use Case Material. Meetings are queered from the start by using only theoretical discussions. Good, practical case studies might induce thinking, analysis, pro and con discussion, and genuine efforts to find a solution among a typical group of participants. If you do break down and use a case, use actual cases. Let everyone know the personalities involved. This will make individuals in the group or known to the group feel "framed" or "put on the spot."

24. Don't Summarize Main Points Before Closing. Increases chances of conference falling flat. If any good topics were discussed the participants won't remember them, can't apply any good suggestions. A good summary is apt to leave the participants with a feeling of accomplishment. An acknowledgment or review of the minority viewpoint, highlighting its merits, but indicating why it was rejected, will remove the minority members' feelings that there is a stigma attached to having been on the wrong side. But don't be tempted to do this. No summary will help kill the present meeting and stultify subsequent conferences.

25. Don't Close Meeting On Time. This is the clincher. Now everyone is mad. Rides and buses have been missed. It is too late for participants to call home and prepare the little wife. Dislike for meetings is built up. You, the leader, are a complete success. You have successfully ruined a company meeting. —The End

If Oil Could Speak

If oil could speak it would have many fascinating truths to tell the non-oil public—truths that would win thousands of new friends for the oil industry.

But, oil can't speak—you can. You, as an individual, can win many new friends for the oil industry if you will pass the true facts on to your non-oil industry friends.

Here are some of those true facts. They are being presented for one purpose: To keep you posted on your industry, so you can tell the story oil is unable to relate.

Read these facts. You will find them informative—and interesting.

"If Oil Could Speak" it would tell the American public:

Is Gasoline Really a Bargain?

Coffee and soft drinks cost $1.60 per gallon, gasoline an average of less than 31 cents. And that price includes almost 8 cents in state and federal taxes.

Is the Oil Industry Fair to Its Employes?

In addition to paying the highest wages in the nation, last year fringe benefits paid out by the oil industry averaged $1278 per employe. This compares with $819 per employe for all industries.

How Much of Our Chemical Supply is Derived from Petroleum?

Of the record-breaking 127 billion pounds of chemicals produced in the U. S. last year, one quarter, or 35 billion pounds were derived from petroleum.

What Does It Cost to Improve Gasoline Quality?

It costs oil companies half a billion dollars to improve the quality of gasoline by one octane number. Yet the average octane number of gasoline has risen from 74 to nearly 100 in the past 27 years.

What Does It Cost to Build Oil Reserves?

In 1956 oil men spent a record three billion dollars searching for and developing 1.2 billion barrels of crude oil reserves. Authorities have estimated that the nation's oil men must discover at least 70 billion barrels of new oil in the next 20 years. This is as much oil as they found from 1859 to 1950.

What Does Oil Do For Me?

The oil industry has created an estimated 60,000 jobs in the city of New Orleans alone. A prime example of the oil industry's contribution to the nation's economic growth.

How Much Gasoline Does the U. S. Consume?

Every minute about 105,000 gallons of gasoline are used in the nation's vehicles, boats and industrial engines—or, 55,188,000,000 gallons per year!

How Do Oil Employes' Wages Compare With Industry As a Whole?

Quoting the Bureau of Labor Statistics, refinery workers' wages increased 60 percent from 1947 to 1955. Whereas the average hourly wage for all manufacturing employes in 1955 was $1.88, the average hourly wage of refining employes was $2.46. U. S. Chamber of Commerce reports the oil industry pays the highest yearly salary—$5259. After petroleum, the four highest average salaries listed are machinery, printing and publishing, transportation equipment and primary materials.

Management Faces Challenge In New Industrial Trends

Oil industry leaders of tomorrow will gear their thinking in terms of:

- Decentralization
- Bigness
- Research
- Electronics
- Education

By E. P. BROOKS
Massachusetts Institute of Technology
Cambridge, Mass.

LOOKING AHEAD, it is certain that management is going to be faced with new, as well as changing conditions. Some of the more important factors include:

1. The effects that the greatly increased demand for goods and services will have on decisions which industrial leaders must make.

2. Pressures to improve the living standard, compounded by the demand for more and more goods.

3. How to cope with the ratio of capital used to the labor content in the production process. Not only will more capital per worker be employed, but the capital in the form of facilities, machines and equipment will be more complex as industry finds more ways to apply the developments of the nation's research laboratories and university research centers.

4. Problems resulting from the diminishment of natural resources. Research and development will be asked to find substitutes or more efficient uses for diminishing raw materials, such as oil and gas. Here, future management will be at the very heart of decisions directing the use of capital and trained minds in this search.

5. Continuation of the struggle between different elements in the industrial society—each for a greater share of the results of the production of goods; the government for taxes, the owners for dividends, and labor for higher wages.

Lastly, among the new or changed conditions that will confront future management is the phenomenon of Bigness.

Every generation has had its bigs: Bigness in the absolute sense rather than in a relative sense—bigness in government, bigness in armaments, bigness in power, in industrial units, bigness in organized labor. The ability to cope with Bigness and make it serve instead of enslave the economy will have a great bearing on the continued rise in the standard of living and on the very structure of the society of the future. Industrial leaders must be developed who have the abilities necessary to cope with this.

To prepare men for future managerial responsibility, these developments become increasingly apparent and helpful as the nation progresses in its industrial growth.

Trend Toward Decentralization. The first of these is a concept of organization of enterprise itself—both as to work and the people who do the work. This is currently talked about glibly, but there still is a great lack of understanding about it. The word that it goes by has different meanings to different people. "Decentralization" means geographical dispersal of units to some people; to others it means new delegations of responsibility and authority; to some it is thought to apply only to large organizations.

What is the basic reason for believing that decentralization of responsibility and authority holds the promise it does as seen by an increasing number of forward-looking executive leaders? The belief rests on this simple fact: It provides the opportunity for creative accomplishment to more people.

Man is essentially a creative being—not all men, to be sure, but certainly more than just a few. One of the great human urges is for the satisfactions which come from creative accomplishment. Unless we are going to depend on developing a breed of super-men to serve as chief executive officers, we must so construct our enterprises that more and more men are scattered throughout the organization who, working within the "purpose of the high command," can bring their own abilities to bear upon the problems over which they preside. This is the sound psychological foundation on which the organizational theory of decentralization rests.

And let those take heed who think the need for spreading responsibility and authority applies only to big companies. Some of the worst examples of the stifling of initiative and the blocking of progress through tight control are to be found in small organizations, by one man. A one-man lordship in a small enterprise can stultify initiative just as the dead hand of bureaucracy stultifies progress in a large-scale operation.

The Electronic Era. The second development which promises to become a new tool to serve management's needs comes from the field of electronics.

Technical research has developed basic principles applying to information flow and physical systems. In addition to these basic principles, the electronic and data-processing developments of the last few years make available a new family of tools which can be employed as aids to making management decisions.

We are on the frontier of a new application of science to the dynamics of industrial and economic systems. In this development the inter-relationship between organization structure and the flow of infor-

mation, money and materials should give management a new insight into some of its most perplexing problems.

The rate of acceptance of these basic principles and electronic machines to implement them will be set by the rate at which management understands and utilizes them. There is one major problem: Technical advances are coming more rapidly than the normal retirement-promotion cycles produce executives trained in using, to best advantage, the new techniques that science makes available. Management at all levels should therefore be made conversant with the new tools now becoming available.

New Role of Education. The third development is a new reliance on education.

Prior to World War II little deliberate attention was paid by management, in general, to improving its managerial talent and to planning for future executive leadership. Chance played a big role in selections for advancement clear up to top echelons. This resulted in important positions being filled by men who had limited experience—usually in one phase of a business. As firms grew in size, environment, social as well as economic, underwent a rapid change. Decision-making involving over-all policy was forced on men whose backgrounds of experience and training were wholly inadequate. True, men were found who made good—but the trial and error method of selection was often pretty costly to a company. There just weren't enough "good" men to keep up with the needs produced by retirement, turnover and growth.

The war brought a tremendous change in the attitude of industry toward training and education. It seemed to dawn on industry all at once that if a firm was to swim, to prosper, even to continue to exist, it dared not leave so much to chance; that all ranks of management had to become more knowledgable, and men had to be prepared for future executive leadership if the company was to continue to be successful.

The movement took two forms.

Inter-Company Training. Training programs became common within companies of all sizes. Usually they commenced at the foreman and supervisory level in production and sales and extended to middle management. Such programs are today of many kinds. Much good effort has been put into them, and much has been accomplished as a result. Efforts are being made now very generally to evaluate these programs, and as a result, considerable improvement in their effectiveness may be expected.

Concurrently at higher levels of management, future personnel needs were estimated and scheduled. Under steadily improving personnel administration, promising men were taken from jobs where they were performing satisfactorily and deliberately placed in other branches of the business—often to the momentary discomfiture of the supervisor in both the old and the new job. Such efforts, within the company, to improve and prepare for the future, are today common in more and more companies both small and large.

External Education. The second form of industry's recognition of its need for education for management has been external to the company.

In the last few years literally tens of thousands of junior, senior and even top executives have spent from a few days to weeks and months, in attendance at seminars or organized courses of study, offered by schools of business and such organizations as the American Management Association.

These programs cover different fields, vary greatly in depth, and are conducted with varying degrees of effectiveness. That they exist in such numbers and are attended by so many thousands year after year, testifies to two significant facts:

- Industry itself through its boards of directors and top management recognizes the need for training their management people and for developing executive talent.
- Individual employes themselves, faced with responsibilities of administration, or management, seek more knowledge, want a less parochial view, wish to make themselves more competent.

The question is often asked whether this extraordinary attendance at such programs is a fad, and whether it will pass with a change in the economy, or for other reasons. The answer is "no," provided such programs continue effectively to serve their purpose. It is a healthy sign that many companies today are making serious attempts to evaluate the results of such external programs on their own men. This is a difficult kind of evaluation, but much is being deduced from trying to evaluate. Here, as in other worlds, "results count."

Current literature on the subject of management training contains many references to the dangers of producing, both in industry and in educational programs, a stereotype class of people. The fear is expressed that we are breeding out boldness, imagination, initiative; that we are relying too heavily on group effort, on how to get along with people.

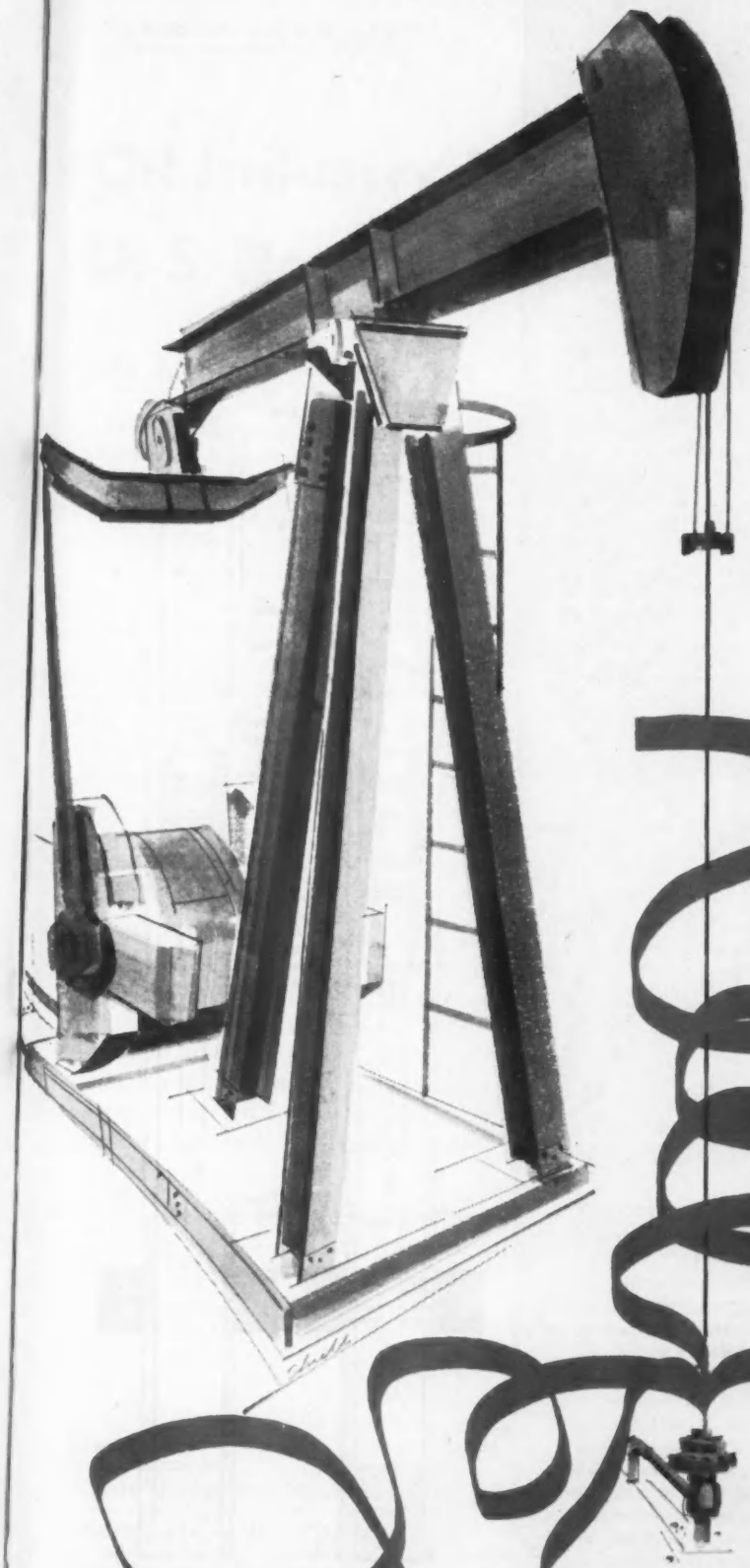
The conditions which give rise to these fears should be recognized and the warnings should be taken seriously, but at present there are no signs that we are losing our traditional American faith in the individual to whom we must always look for progress.

ACKNOWLEDGMENT

This article is based on a talk before business executives, engineers and others attending an engineering conference at Tulsa, sponsored by faculty members and alumni of the Massachusetts Institute of Technology.

About the Author

EDWARD P. BROOKS is dean of the School of Industrial Management at Massachusetts Institute of Technology. He received his B.S. degree at M.I.T. in 1917, then after World War I, he became assistant to the vice president of American Cotton Oil Co., New York, spent a year with The Barrett Co., and in 1924 joined Montgomery-Ward Co. as a buyer. Then except for a brief period as assistant to the vice president of United States Steel Corp., he spent the next 24 years with Sears Roebuck & Co. where in 1941 he was made a director. Brooks was a term member of the M.I.T. Corp. from 1940 to 1945, and has served on the board of many companies and charitable organizations.



are you pumping red tape?

If you are there's no quick, easy solution to your problem. But an answer must be found. The red tape of oil operation can choke production as surely as a well that is sanding up. These higher operation costs can cut your profit to the point that you are working only for your creditors.

Although you have no control over your sales price, you can control your costs. Working with your legal and tax counsel, The Commerce can analyze your costs, find where economies can be effected, thereby increasing the profitableness of your operation by helping you to cut your costs. Your income goes up when you stop pumping red tape.

Facilities of The National Bank of Commerce Oil Loan Department are available in Wyoming, Nebraska, Colorado, New Mexico, Texas, Louisiana, and Mississippi.

E. O. Buck, vice president, Oil Loan Department

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

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Gulf Building, Houston, Texas

BAKER Packers put the "permanent" in permanent-type completions

When you select a Packer for a Permanent-Type Well Completion, remember this fact: of all the tools used in permanent-type well completions, only the PACKER is required to be *permanent*. Guns, Extensions, Plugs, Gas-Lift and Circulating Valves can be removed or replaced on wire line . . . but the Packer, like the casing, is required to perform for the life of the selected producing intervals. Baker Packer Completions are *permanent completions* from the standpoint of packer performance.

Baker Retainer Production Packer Product No. 415-D

Baker Retainer Production Packers have many important advantages . . . Meet dimensional requirements of Permanent-Type Well Completions; provide permanent, reliable pack-off which will hold against any pressure differential (from above or below) that is safe for the casing; Tubing String is free because neither set-down tubing weight nor tubing tension is required to achieve and maintain pack-off, although the tubing may be anchored to the packer if desired; Tubing String readily removed. Packer can be set on a wire line; is readily drillable, and can be used as either a Squeeze or Production Tool.

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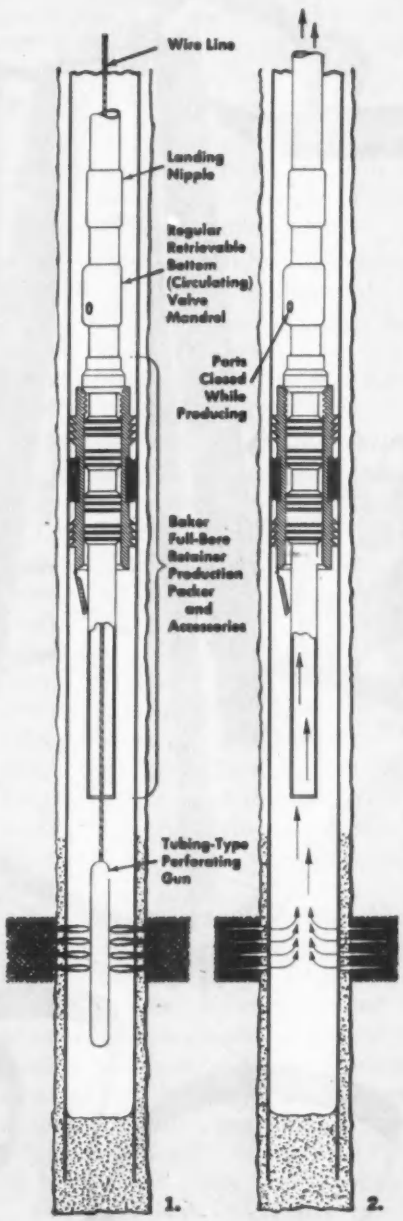

One of the many types of Permanent-Type Completions is shown above. After perforating (1) and retrieving the cable head and collar locater, the well is put on production (2). All subsequent work-overs, such as squeeze cementing to improve gas/oil ratios, are conducted with special tools which are run through the tubing string.

Oil Industry Investment in U. S. Reaches $54.5 Billion

By L. J. LOGAN, World Oil Staff

Gross investment in the U. S. petroleum industry had increased by the end of 1956 to $54.5 billion. That was an increase of $3.8 billion from one year previously.

The new total included $43.7 billion in property, plant, and equipment, $10.2 billion in current assets, and $0.6 billion in other assets.

These figures have been reported in the recently issued annual financial analysis of the industry by the Chase Manhattan Bank. The 44-page pamphlet was prepared by Frederick G. Coqueron, Norma J. Anderson, and David P. Haskell, of the bank's Petroleum department.

Assets by Departments. Of the $43.7 billion of gross investment in property, plant, and equipment at end of 1956, $25 billion or 57.2 percent was in crude oil and natural gas production. Gasoline and cycling plants accounted for $1 billion or 2.3 percent. Investment in refineries and chemical plants totaled $7.85 billion or 18 percent. That in marketing was $4.7 billion or 10.7 percent.

All transportation facilities involved investment of $4,525,000,000 or 10.4 percent, including $3,175,000,000 or 7.3 percent in pipe lines, $1 billion or 2.3 percent in marine items, and $350 million in other transportation. Miscellaneous facilities were worth $625 million or 1.4 percent of the industry total.

Expenditures in 1956. For facilities in the U. S. the petroleum industry in 1956 made capital expenditures totaling $6.05 billion, an increase of $450 million over the amount spent in 1955.

The 1956 expenditures included $4.375 billion or 72.3 percent for crude oil and natural gas production; $100 million or 1.7 percent for gasoline and cycling plants; $825 million or 13.6 percent for refineries and chemical plants; $450 million or 7.4 percent for marketing; $55 million or 0.9 percent for miscellaneous items; and $245 million or 4.1 percent for transportation facilities, including $175 million or 2.9 percent for pipe lines, $50 million or 0.8 percent for marine equipment, and $20 million or 0.4 percent for other transportation.

Estimated Assets Employed (or Investment) in U. S. Petroleum Industry December 31, 1956

ITEM	Net Assets		Gross Assets	
	$ Million	% of Total	$ Million	% of Total
Current Assets	10,200	30.6	10,200	18.7
Property, Plant and Equipment	22,500	67.6	43,700	80.2
Other Assets	600	1.8	600	1.1
Total	33,300	100.0	54,500	100.0

Source: Chase Manhattan Bank Bulletin, "Petroleum Industry . . 1956."

Recent Annual Expenditures for and Current Investment in Property, Plant, and Equipment

Source: Chase Manhattan Bank Bulletin, "Petroleum Industry . . . 1956"

Department	Estimated Expenditures for Property Plant, and Equipment in Past 10 Years						Estimated Investment Dec. 31, 1956 in Property, Plant and Equipment			
	1956		1955		10 Years 1947-1956		Gross		Net	
	$ Million	% of Total	$ Million	% of Total	$ Million	% of Total	$ Million	% of Total	$ Million	% of Total
*Crude and Natural Gas Production	4,375	72.3	4,050	72.3	28,840	68.4	25,000	57.2	12,000	53.4
Gasoline and Cycling Plants	100	1.7	50	0.9	860	2.1	1,000	2.3	500	2.2
Transportation Department	245	4.1	240	4.3	3,115	7.4	4,525	10.4	2,500	11.1
Pipe Lines	175	2.9	190	3.4	2,305	5.5	3,175	7.3	1,825	8.1
Marine	50	0.8	35	0.6	635	1.5	1,000	2.3	525	2.3
Other	20	0.4	15	0.3	175	0.4	350	0.8	150	0.7
Refineries and Chemical Plants	825	13.6	835	14.9	5,625	13.3	7,850	18.0	4,125	18.3
Marketing	450	7.4	375	6.7	3,120	7.4	4,700	10.7	2,975	13.2
Others	55	0.9	50	0.9	590	1.4	625	1.4	400	1.8
Total, All Departments	6,050	100.0	5,600	100.0	42,150	100.0	43,700	100.00	22,500	100.0

* Expenditures include cost of drilling dry holes, but exclude exploration expenses and lease rentals charged to income account. Investment includes only natural gas producing, transmission and distribution facilities of oil companies.

Oil Industry Earnings Up 17 Percent in First Half

Gains over 1956 reflect higher crude and product prices and emergency exports to Europe.

EARNINGS OF the petroleum industry were exceptionally good in the first half of 1957.

Some companies experienced unfavorable trends of earnings in the second quarter, in comparison with first quarter results. But for the industry as a whole, earnings ran about 16 percent above last year for the second quarter, or only a little below the first quarter's 19 percent gain. For the first half, profits were about 17 percent above 1956. (See Table.)

The increase in earnings this year was caused principally by two factors. First was the marking up of crude oil and product prices generally in January of this year. Second was the abnormal expansion of demand for crude and fuel oils in supplying emergency requirements of Western Europe during the closure of the Suez Canal.

Both of those influences were felt more strongly in the initial quarter than in the second quarter of this year. In the second quarter the abnormal exports tapered off, and U. S. crude production and refinery runs were reduced. Volumes of sales by oil companies consequently diminished. Meanwhile, there was also some weakening of refined product prices.

A factor unfavorably affecting oil company profits this year has been the further increase in costs of labor and materials. Wages and salaries were increased in early spring. Prices of steel goods and other materials have been substantially marked up. Oil company operating costs are running considerably higher in 1957 than in 1956.

In the third quarter of 1957, oil industry earnings continue to be affected unfavorably by the trends that began developing in the second quarter. Crude oil production allowables in Texas, Louisiana, and other states continued relatively low in July and August, and will remain low in September. Curtailment of operations will largely offset the advantage of this year's better crude prices.

While domestic crude production is being curtailed, imports of crude and products also are due to be restricted, under the program sponsored by the federal government.

Companies of all categories are being affected by the forces currently narrowing profits, including the curtailments of operations, unsteadiness of some product prices, and the generally increased costs of doing business.

Net Earnings of Some Oil Companies in Second Quarter and First Half, 1957 vs. 1956

COMPANY	SECOND QUARTER			FIRST HALF		
	1957	1956	% DIF.	1957	1956	% Diff.
Amerada Petroleum	$ 6,901,341	$ 5,929,028	+ 16.4	$ 15,646,953	$ 13,551,976	+ 15.5
AmericanMaracaibo	807,598	529,133	+ 52.6	1,667,800	1,199,739	+ 39.0
Anderson-Prichard	1,336,043	1,429,260	— 6.5	2,819,633	2,782,084	+ 1.3
Ashland O&R	3,656,173	3,103,592	+ 17.8	8,575,448	6,754,517	+ 27.0
Atlantic Refining	10,544,237	9,973,000	+ 5.7	25,292,821	22,148,907	+ 14.2
Aztec Oil & Gas	207,316	115,168	+ 80.0	508,661	280,870	+ 81.1
Bishop Oil	42,000	80,888	— 48.1	144,142	199,640	— 27.8
Champlin O&R	2,234,452	2,195,000	+ 1.8	5,341,557	4,541,000	+ 17.6
Cities Service	12,889,000	12,225,000	+ 5.4	36,315,000	30,405,000	+ 19.4
Colorado O&G	763,992	622,847	+ 22.7	1,454,279	1,155,892	+ 25.8
Continental Oil	10,074,000	11,755,000	— 14.3	23,714,000	25,549,000	— 7.2
*Creole Petroleum	113,341,000	75,212,000	+ 50.7	221,648,000	158,655,000	+ 39.7
Getty Oil	3,656,142	1,386,459	+163.7	12,962,122	3,719,669	+248.5
Gulf Oil	106,815,510	68,753,000	+ 55.4	201,754,510	138,072,000	+ 46.1
Honolulu Oil	3,772,532	3,112,341	+ 21.2	7,616,233	6,861,477	+ 11.0
*Humble O&R	49,588,500	43,060,500	+ 15.2	107,788,500	92,360,500	+ 16.7
*Imperial Oil, Ltd	16,062,000	14,523,624	+ 10.6	37,662,000	33,735,194	+ 11.6
*International Pet	12,200,000	9,200,000	+ 32.6	23,300,000	18,500,000	+ 25.9
Louisiana L. & E.	5,031,482	3,454,615	+ 45.6	10,502,804	7,059,786	+ 48.8
Maracaibo Oil Expl	130,150	133,732	— 2.7	701,719	278,183	+152.3
Ohio Oil	9,566,644	9,504,192	+ 0.7	22,232,652	21,275,728	+ 4.5
Phillips Petroleum	25,019,207	23,233,481	+ 7.7	53,398,637	51,565,719	+ 3.6
Plymouth Oil	1,885,662	1,973,647	— 4.5	4,405,038	4,256,678	+ 3.5
Pure Oil	8,842,000	8,642,000	+ 2.3	19,012,000	17,826,000	+ 6.7
Quaker State Oil	588,213	667,139	— 11.8	958,160	1,192,820	— 19.7
Richfield Oil	6,665,956	7,020,016	— 5.1	13,704,817	14,531,575	— 5.7
Seaboard Oil	3,033,585	2,311,665	+ 31.2	6,426,427	4,974,575	+ 29.2
Shell Oil	33,871,344	34,430,552	— 1.6	75,320,849	69,440,912	+ 8.5
Signal O&G	2,960,000	2,125,255	+ 39.3	6,140,000	4,568,462	+ 34.4
Sinclair Oil	18,546,098	20,858,150	— 11.1	44,848,197	45,103,719	— 0.6
Skelly Oil	8,545,296	7,507,060	+ 13.8	19,933,551	15,540,112	+ 28.3
Socony Mobil Oil	62,000,000	62,000,000	.....	132,000,000	124,000,000	+ 6.5
Standard (Calif.)	66,856,154	60,556,309	+ 10.4	136,328,987	122,050,274	+ 11.7
Standard (Ind.)	36,725,902	34,525,645	+ 6.4	82,576,935	75,903,508	+ 10.2
Standard (N.J.)	226,000,000	187,000,000	+ 20.9	463,000,000	392,000,000	+ 18.1
Standard (Ohio)	4,781,719	6,933,312	— 31.0	12,623,009	13,450,544	— 6.2
Sun Oil	11,856,326	12,883,320	— 8.0	25,187,436	25,138,552	+ 0.2
Sunray Mid-Cont	17,632,380	8,912,545	+ 97.8	33,929,000	20,297,576	+ 67.2
Texas Gulf Prod	1,786,700	1,395,507	+ 28.0	3,665,700	3,193,000	+ 14.8
Texas Pacific Coal	1,880,931	1,711,233	+ 9.9	3,949,056	3,766,149	+ 4.9
The Texas Company	78,721,713	68,130,366	+ 15.5	165,145,982	138,088,709	+ 19.6
Tidewater Oil	9,610,000	12,562,000	— 23.5	20,945,000	21,599,000	— 3.0
Union of Calif.	7,399,939	6,587,926	+ 12.3	16,727,071	13,618,151	+ 22.8
Universal Consol	945,986	855,745	+ 10.5	1,927,137	1,754,032	+ 9.9
Venezuelan Pet.	1,506,760	2,085,385	— 27.8	3,716,397	4,361,715	— 14.8
Wilcox Oil	280,785	241,867	+ 16.1	534,623	541,586	— 1.3
Woodley Petroleum	900,000	462,512	+ 94.6	1,750,000	964,259	+ 81.5
*Total, 43 Companies	825,581,268	709,914,892	+ 16.3	1,725,974,343	1,475,563,095	+ 17.0

* Creole, Humble, Imperial Oil, and International Petroleum are excluded from totals, being included as affiliates of Standard Oil Company (N.J.).

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By **RAY L. DUDLEY,** Publisher, and **WARREN L. BAKER,** Editor

Little Relief Seen for U. S. Producers

Higher demand and possibility of reduced imports improve outlook, but promise very little relief from exceptionally low per well producing rates.

An improved statistical position is in prospect for the U. S. oil industry during the remainder of 1957. Much higher demand, as it builds toward the usual winter peak, and the promise of reduced crude imports materially brighten the outlook.

However, U. S. producers are not likely to feel the full impact of the improved outlook. Greater demand and reduced imports should be used to cure surplus inventories. Excessive supply, regardless of its source, spells an unhealthy situation. Therefore, producers are confronted with a continued need to restrain domestic producing rates.

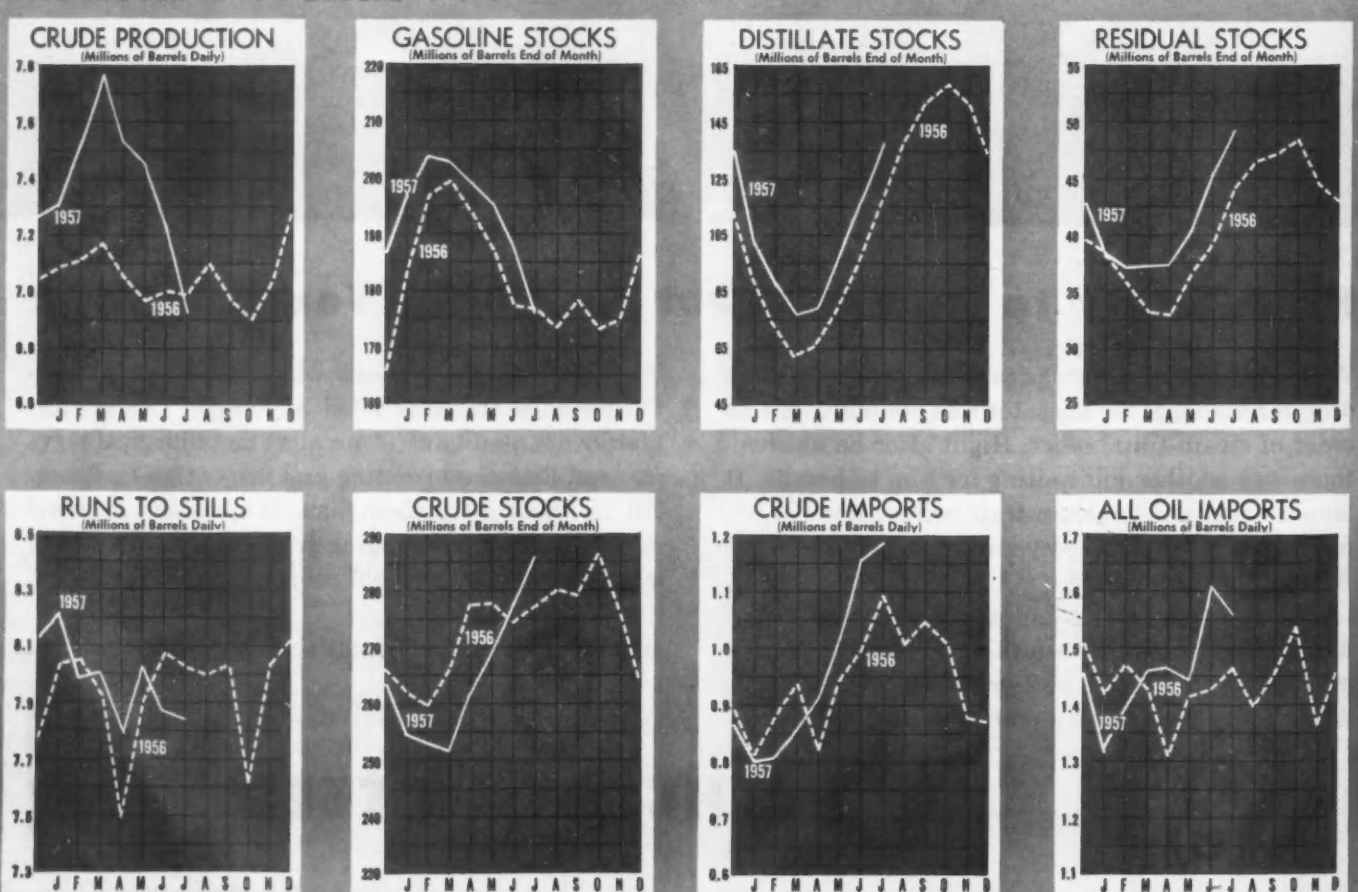
Consequently, coming months do not promise U. S. oil producers much relief from recent drastic production cuts. Some increase in producing rates is probable. But if surplus inventories are to be corrected, production gains cannot be of sufficient magnitude to make much difference in per well producing rates.

The relief will be small by the time any increase in production is divided among the many thousands of U. S. producers.

The Independent Petroleum Association of America has forecast that total demand will average 9,730,000 barrels daily during the last four months of 1957. This would represent an increase of 1,080,000 barrels over the May-June-July period. However, in view of inventories, natural gasoline output, and probable imports, the association sees this prospect as indicating a daily average demand for U. S. crude oil of 7,200,000 barrels, only 200,000 barrels greater than in July and August.

If half of this amount (100,000 barrels daily) is absorbed by Texas wells it would mean: prorated wells in the state still would be shut in

Petroleum Trends . . .



more than half the time; an increase of just over half a barrel per well for the state's 177,000 producing wells. This would not be much relief.

Texas wells have suffered more than wells in other leading states as U. S. production was curtailed to around 6,900,000 barrels per day in July and August. This level was 800,000 barrels below the March peak and even slightly under the quantity produced in October, 1956, just prior to the Suez Canal crisis.

However, Texas' output in July and August averaged only 2,800,000 barrels per day compared with 3 million barrels in October, 1956. July production in Louisiana, New Mexico, Oklahoma and Kansas was considerably higher than in October, 1956. Reductions in August brought New Mexico, Oklahoma and Kansas almost back to their October, 1956, rates. Although Louisiana output was reduced in August, it was still 65,000 to 70,000 barrels higher than in October, 1956.

Well allowables in Texas have been cut and cut until they are down to the minimum limit. Besides limiting daily well production, Texas will continue its 13-day production schedule in September. This is the third month in which Texas wells have been limited to 13 producing days per month, a sharp reduction from previous years. The trend in average number of producing days allowed Texas wells per month is as follows:

1952	21.68
1953	19.66
1954	16.17
1955	16.17
1956	15.83
First Half 1957	16.00
3rd Quarter 1957	13.00

Even with these conditions, purchaser proration exists in the state. Gulf Oil Corporation in mid-August began taking only 10 days of production per month, similar to the company's purchase rate inaugurated earlier in New Mexico, Oklahoma, Louisiana, Mississippi and Alabama.

A turn for the better occurred in the industry's statistical position during July and August. Additional improvement is in prospect for September. Although domestic production will be somewhat larger in September, higher demand should take care of the increase. It is also possible that supply may experience its first benefits from the Government program for reduced crude imports.

U. S. Crude Production by States

(THOUSANDS OF BARRELS)

STATE or DISTRICT	DAILY AVERAGE PRODUCTION				TOTAL PRODUCTION FIRST SEVEN MONTHS		
	July 1957	June 1957	July 1956	% Diff. 1957-1956	1957	1956	% Diff. 1957-1956
Alabama	13.2	12.3	9.4	+ 40.4	2,812	1,417	+ 98.4
Arkansas	84.5	85.9	80.7	+ 4.7	18,107	16,727	+ 8.3
California	930.8	926.1	962.0	— 3.3	197,505	205,758	— 4.0
Colorado	151.9	149.9	159.8	— 5.0	32,823	34,499	— 4.9
Florida	1.3	1.3	1.3	.....	273	285	— 4.2
Illinois	158.1	184.3	219.9	— 28.1	43,428	47,860	— 9.3
Indiana	28.1	29.3	31.4	— 10.5	7,264	6,268	+ 15.9
Kansas	338.6	343.8	339.5	— 0.3	70,857	72,634	— 2.5
Kentucky	39.1	42.1	47.6	— 17.9	9,491	10,206	— 7.0
Louisiana	867.4	879.3	780.0	+ 11.2	202,234	171,069	+ 18.2
North Louisiana	129.2	134.7	125.7	+ 2.8	28,722	27,051	+ 4.4
South Louisiana	738.2	744.6	654.3	+ 12.8	173,512	144,018	+ 20.5
Michigan	27.5	27.9	29.3	— 6.1	5,992	6,437	— 6.9
Mississippi	117.0	115.0	110.4	+ 6.0	24,333	23,541	+ 3.4
Missouri	0.1	0.1	0.1	.....	36	37	— 2.7
Montana	74.1	73.5	61.0	+ 21.5	15,312	12,168	+ 25.8
Nebraska	52.2	51.6	46.3	+ 12.7	10,685	9,086	+ 17.6
Nevada	0.1	0.1	0.2	— 50.0	18	42	— 57.2
New Mexico	254.1	258.4	234.6	+ 8.3	55,468	50,616	+ 9.6
Southeast New Mexico	249.6	254.3	229.4	+ 8.8	54,295	49,847	+ 8.9
Northwest New Mexico	4.5	4.1	5.2	— 13.5	1,173	769	+ 52.5
New York	7.2	7.7	7.5	— 4.0	1,585	1,601	— 1.0
North Dakota	38.6	37.7	37.9	+ 1.8	8,285	7,711	+ 7.4
Ohio	16.6	14.3	13.3	+ 24.8	3,020	2,707	+ 11.6
Oklahoma	571.8	580.4	573.9	— 0.4	129,615	126,771	+ 2.2
Pennsylvania	22.6	24.0	22.4	+ 0.9	4,917	4,767	+ 3.1
South Dakota	0.2	0.1	0.1	+100.0	19	18	+ 5.6
Tennessee	0.1	0.1	0.1	.....	5	5	.....
Texas	2,803.5	3,080.2	3,024.4	— 7.3	664,433	648,461	+ 2.5
Dist. 1: South Central	52.5	53.9	56.4	— 6.9	11,812	11,491	+ 2.8
Dist. 2: Middle Gulf	134.6	150.8	154.4	— 12.8	33,072	33,659	— 1.8
Dist. 3: Upper Gulf	426.3	457.5	457.3	— 6.8	97,726	96,949	+ 0.8
Dist. 4: Lower Gulf	216.6	203.2	239.8	— 9.7	50,790	52,245	— 2.8
Dist. 5: East Central	36.4	40.0	44.2	— 17.7	8,651	9,751	— 11.3
Dist. 6: Northeast	302.1	338.5	339.0	— 10.9	73,501	73,751	— 0.3
Dist. 7-B: North Central	151.6	165.9	156.2	— 3.0	34,905	33,208	+ 5.1
Dist. 7-C: West Central	144.2	164.5	186.3	— 22.6	35,768	39,386	— 9.2
Dist. 8: West	1,031.9	1,160.7	1,056.4	— 2.3	246,159	222,473	+ 10.6
Dist. 9: North	201.9	212.6	215.4	— 6.3	45,030	44,767	+ 0.6
Dist. 10: Panhandle	105.5	102.6	97.4	+ 8.3	22,230	20,122	+ 10.5
Utah	10.7	8.3	5.6	+ 91.1	2,121	1,073	+ 97.7
Virginia	0.1	0.1	.....	+100.0	8	6	+ 33.3
West Virginia	6.1	6.0	5.9	+ 3.4	1,271	1,280	— 0.7
Wyoming	291.7	291.4	285.9	+ 2.0	62,287	60,926	+ 2.2
Total United States	6,907.3	7,231.2	7,090.5	— 2.3	1,574,204	1,523,976	+ 3.3

Source: Bureau of Mines and API. Texas districts data from API and do not necessarily agree with state totals.

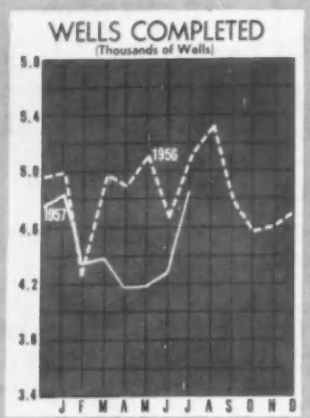
U. S. Crude Oil and Refined Product Trends

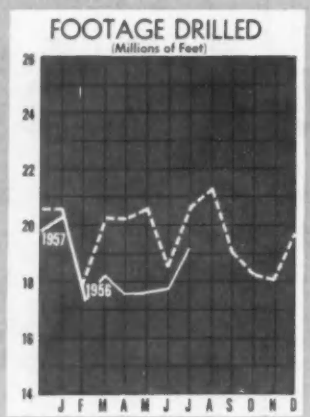
(THOUSANDS OF BARRELS)

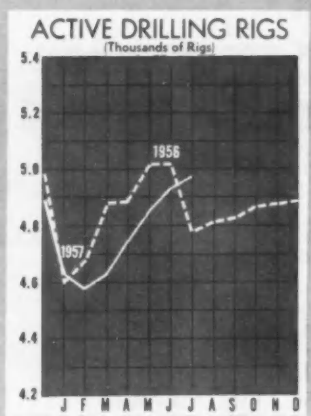
MONTH	CRUDE OIL			GASOLINE		DISTILLATE FUEL		RESIDUAL FUEL		DAILY IMPORTS	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Crude Oil	Total Oils
1955:											
November	7,014	7,692	260,707	3,867	157,871	1,680	141,808	1,214	44,071	823	1,322
December	7,155	7,762	265,610	3,916	165,433	1,765	111,333	1,286	39,174	884	1,502
1956:											
February	7,208	8,047	259,504	3,854	196,092	1,918	71,335	1,286	35,675	878	1,472
March	7,278	7,914	265,683	3,829	199,698	1,808	60,846	1,213	32,984	934	1,425
April	7,146	7,487	277,121	3,646	193,299	1,713	63,571	1,130	32,740	815	1,305
May	7,064	7,896	277,497	3,859	186,673	1,667	75,928	1,149	35,607	938	1,416
June	7,100	8,071	274,491	3,976	177,076	1,755	93,758	1,098	39,073	987	1,426
July	7,090	8,014	277,008	3,975	176,536	1,767	115,787	1,066	43,958	1,084	1,463
August	7,195	7,995	279,944	4,037	172,939	1,839	137,905	1,091	46,617	1,001	1,399
September	7,054	8,024	278,791	3,991	177,974	1,845	150,411	1,062	47,342	1,043	1,452
October	6,966	7,608	286,560	3,773	172,798	1,772	158,871	1,082	48,400	1,004	1,541
November	7,139	8,031	275,995	3,913	174,808	1,841	151,517	1,182	44,590	871	1,362
December	7,377	8,141	266,014	4,039	187,271	1,981	133,981	1,288	44,491	873	1,471
1957:											
January	7,480	8,274	256,669	3,991	197,702	2,118	100,572	1,322	38,403	805	1,421
February	7,682	8,088	256,344	3,864	205,270	2,035	85,105	1,270	36,201	780	1,430
March	7,717	8,047	254,911	3,826	206,716	1,861	76,245	1,205	37,371	836	1,464
April	7,541	7,740	265,796	3,770	201,407	1,764	78,743	1,132	37,429	906	1,542
May	7,442	7,992	275,963	3,900	194,770	1,789	98,135	1,103	41,125	1,042	1,558
June	7,231	7,876	277,532	3,898	187,407	1,743	116,966	1,129	45,342	1,173	1,605
July	6,907	7,850	285,656	3,812	175,952	1,749	127,600	1,095	49,082	1,188	1,556
Week Ended:											
8-9-57	6,797	8,008	284,372	3,971	172,973	1,725	141,999	1,078	50,138	1,278	1,680
8-10-56	7,086	7,985	274,389	3,952	177,557	1,760	124,173	1,123	45,541	985	1,335

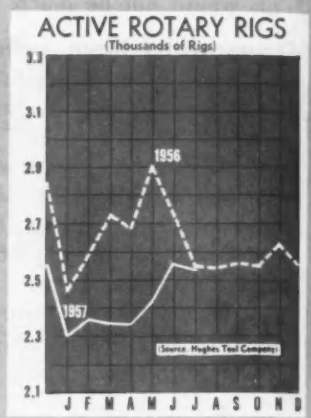
Source: Data for last two months from API; prior monthly data from Bureau of Mines.

Drilling Activities . . .









July's Wells Hit New Peak As Drilling Gains Momentum

By CECIL W. SMITH, WORLD OIL Staff

THERE WERE MORE new wells completed in July than have been recorded in any month this year. After six months of relatively quiet activity, the nation's drillers were pushing their rigs at about the same rate that made last year the top drilling period of all time.

During the first half of 1957, each month saw the margin of difference between the two periods grow wider, until at the end of June the 1957 deficit amounted to 9.8 percent. Then, as WORLD OIL (Aug. 15, 1957) forecast, the nation's drilling rates turned upward. The first month after the turn into the last half of the year saw this margin lowered to 9.2 percent and with excellent prospects for a continued narrowing of the difference. By the end of the year, total new wells should be less than 5 percent under last year's record-breaking amount. Although no new drilling volume records will be set, it should be considered a very successful year. Especially so after the almost dismal outlook available early in the year.

A total of 4878 new wells was completed in July to set a new monthly high for the year. That amounted to almost 600 wells more than was recorded in the previous month. However, it failed by 300 of matching the results obtained in the same month of 1956.

The month's high rate of drilling activity boosted the year's seven months' total to 30,954 new wells, which was 3121 wells or 9.2 percent less than the aggregate of a year before.

Not only have the nation's new wells been less numerous, but, making matters worse, has been the increase in the rate of drilling non-producers. Oil producers drilled in seven months totaled 16,285, which was 10.8 percent less than those completed in the comparable period of 1956. Gas and gas-distillate producers totaling 2498 failed by 3 percent of matching those completed a year before. In all, 18,783 producing wells were 9.8 percent less than last year's 20,821. This year, 60.7 percent of all wells drilled were producers, while a year earlier the score had been 61.1 percent productive.

Active drilling rigs totaled 4983 in the U. S. at the end of July. That was an increase of 53 during the month and represented the highest concentration of active tools this year. The last half of the year should see drilling rates of a high order.

Summary of U. S. Drilling Activity

ITEM	July 1957	June 1957	SEVEN MONTHS January-July 1957	1956	Percent Diff.
New Wells Completed:					
Oil	2,481	2,083	16,285	18,245	—10.8
Distillate	70	45	393	311	+26.4
Gas	325	332	2,105	2,265	— 7.1
Service	115	86	609	535	+13.8
Dry	1,887	1,738	11,562	12,719	— 9.1
Total Wells	4,878	4,284	30,954	34,075	— 9.2
Footage Drilled (Mln. of Feet)	19.4	17.7	127.9	138.5	— 7.7

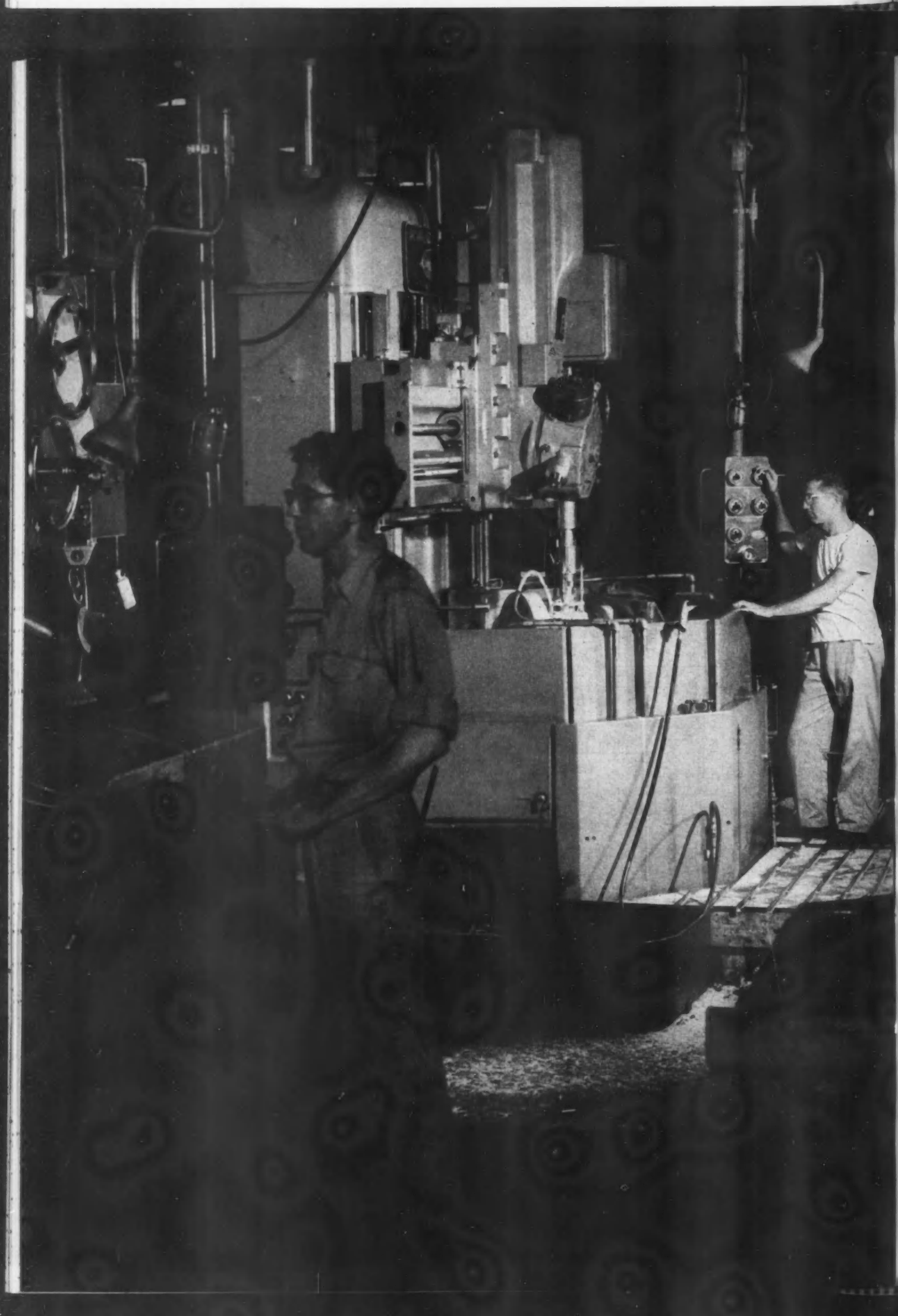
Summary of U. S. Wildcat Drilling

ITEM	July 1957	June 1957	SEVEN MONTHS January-July 1957	1956	Percent Diff.
New Field Discoveries:					
Oil	73	51	472	624	—24.4
Distillate	6	5	70	58	+20.7
Gas	14	17	129	123	+ 4.9
Total Discoveries	93	73	671	805	—16.7
Dry Wildcats	935	884	5,901	6,354	— 7.1
Total Wildcats	1,028	957	6,572	7,159	— 8.2
Percent Productive	9.0	7.6	10.2	11.2	.....
Percent Dry	91.0	92.4	89.8	88.8	.....

U. S. Drilling Activity in July and First Seven Months, 1957-1956

STATE or DISTRICT	TOTAL NEW WELLS COMPLETED AND FOOTAGE DRILLED: DETAILS FOR JULY, 1957 — Oil	Dist.	Gas	Dry	Service Wells	TOTAL NEW WELLS — July 1957	June 1957	July 1956	Total Footage July 1957	DETAILS FOR JANUARY-JULY: NEW WELLS — 1957	1956	Percent Diff.	FOOTAGE — 1957	1956	WILDCAT DRILLING IN JULY AND FIRST SEVEN MONTHS, 1957-1956: DETAILS FOR JULY, 1957 — Oil	Dist.	Gas	Dry	Total Wildcats	DETAILS FOR JANUARY-JULY — Oil	Dist.	Gas	Dry	TOTAL WILDCATS — 1957	1956	DRILLING RIGS IN OPERATION — July 31 1957	June 30 1957	July 31 1956
Alabama	3	....	....	2	....	5	11	10	43,474	67	56	+ 19.6	588,211	444,923	....	....	....	2	2	....	....	1	23	24	18	7	11	15
Arizona	....	....	....	1	....	1	....	4	2,202	1	4	— 75.0	2,202	4,000	....	....	....	1	1	....	....	....	1	1	4	4	5	3
Arkansas	63	....	....	45	1	109	115	91	344,633	616	498	+ 23.7	1,848,600	1,566,690	....	....	....	20	20	4	....	....	89	93	86	64	82	56
California	116	....	8	52	....	176	190	184	696,334	1,265	1,245	+ 1.6	5,388,124	5,890,862	....	....	....	33	33	5	....	3	206	214	151	177	184	184
Colorado	12	1	6	47	....	66	73	99	345,115	468	750	— 37.6	2,441,285	3,945,850	3	1	....	36	40	12	1	7	266	286	370	65	59	70
Florida	....	....	....	2	....	2	....	1	16,770	8	7	+ 14.3	57,082	39,121	....	....	....	2	2	....	....	....	8	8	7	1	1	1
Georgia	....	....	....	....	....	....	....	2	.....	3	5	— 40.0	18,955	22,008	....	....	....	....	....	....	....	....	3	3	5	....	1	....
Idaho	....	....	....	....	....	....	....	....	.....	1	1	.....	3,947	4,528	....	....	....	....	....	....	....	....	1	1	1	....	....	1
Illinois	81	....	2	141	....	224	229	365	527,037	1,411	2,151	— 34.4	3,182,127	5,064,889	2	....	....	73	75	9	....	1	419	429	566	255	254	302
Indiana	18	....	....	49	1	68	50	61	113,640	391	364	+ 7.4	620,942	638,333	....	....	....	19	19	1	....	....	105	106	98	119	106	85
Kansas	159	....	27	184	8	378	356	382	1,345,158	2,401	2,745	— 12.5	8,551,554	9,672,039	13	....	1	88	102	65	....	18	497	580	723	581	584	486
Kentucky	63	....	11	102	....	176	165	186	270,173	920	1,043	— 11.8	1,385,158	1,516,373	2	....	....	8	10	12	....	....	57	69	94	126	123	136
Louisiana	157	17	21	119	....	314	335	356	2,235,685	2,104	2,136	— 1.5	17,102,743	15,889,639	3	....	....	42	45	17	23	8	286	334	365	422	396	413
North Louisiana	70	4	10	48	....	132	123	173	484,627	754	883	— 14.6	2,805,807	3,206,161	....	....	....	16	16	3	2	2	86	93	119	78	68	79
South Louisiana	87	13	11	71	....	182	212	183	1,751,058	1,350	1,253	+ 7.7	14,296,836	12,683,478	3	....	....	26	29	14	21	6	200	241	246	344	328	334
* Gulf of Mexico	28	2	3	22	....	55	72	42	492,509	403	261	+ 54.4	3,763,114	2,409,870	2	....	....	4	6	7	4	2	33	46	39	92	94	62
Maryland	....	....	....	....	....	....	....	4	.....	.....	4	—100.0	.....	30,716	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Michigan	10	....	6	12	....	28	30	36	77,612	220	271	— 18.8	629,028	767,848	....	....	....	3	3	7	....	....	76	83	93	74	77	71
Mississippi	3	4	2	22	....	31	20	38	261,468	209	248	— 15.7	1,474,319	1,798,366	....	1	....	16	17	7	1	....	104	112	106	42	39	33
Missouri	....	....	....	2	....	2	....	4	2,381	3	21	— 85.7	2,751	23,811	....	....	....	2	2	....	....	....	4	4	15	....	1	1
Montana	25	....	1	18	....	44	46	50	200,338	222	245	— 9.4	1,157,807	1,222,283	....	....	....	14	14	2	....	1	66	69	87	48	52	64
Nebraska	29	....	....	55	....	84	84	84	489,826	507	596	— 14.9	2,989,575	3,439,401	....	....	....	43	43	19	....	1	243	263	292	49	49	31
Nevada	....	....	....	....	....	....	....	2	.....	3	5	— 40.0	5,718	28,571	....	....	....	....	....	....	....	....	3	3	3	3	1	3
New Mexico	96	2	54	39	....	191	190	200	870,803	1,307	1,147	+ 13.9	5,963,018	5,148,169	4	2	1	25	32	29	2	4	143	178	146	194	186	190
New York	21	....	1	2	24	48	39	44	69,900	279	241	+ 15.8	464,000	338,100	....	....	....	....	....	....	....	....	....	....	....	62	58	65
North Dakota	12	....	....	9	....	21	18	30	162,256	153	169	— 9.5	1,082,933	1,256,299	2	....	....	9	11	8	....	....	59	67	55	28	28	27
Ohio	52	....	24	30	....	106	96	81	238,151	575	580	— 0.9	1,389,913	1,421,702	....	....	....	2	2	....	....	....	5	5	3	224	215	216
Oklahoma	301	7	28	193	23	552	361	666	1,935,542	3,361	4,786	— 29.8	12,207,914	17,201,426	6	....	2	55	63	38	6	13	320	377	491	618	564	634
Oregon	....	....	....	1	....	1	1	....	1,666	2	1	+100.0	10,392	12,880	....	....	....	1	1	....	....	....	2	2	1	1	1	....
Pennsylvania	35	....	19	3	34	91	76	71	192,922	539	463	+ 16.4	1,482,008	1,302,448	....	....	1	....	1	....	....	19	7	26	.....	184	172	155
South Dakota	1	....	....	1	....	2	2	3	10,334	27	7	+ 85.7	105,867	42,713	....	....	....	1	1	....	....	....	25	25	7	1	1	2
Texas	1,174	39	67	687	19	1,986	1,639	1,995	8,279,626	12,997	13,287	— 2.2	54,302,419	55,967,880	35	2	6	405	448	220	37	41	2,706	3,004	3,179	1,304	1,354	1,205
Dist. 1: South Central	67	1	2	31	....	101	94	187	251,403	797	1,236	— 35.5	1,994,748	3,300,682	6	....	1	22	29	13	1	1	210	225	313	49	47	54
Dist. 2: Middle Gulf	24	11	11	38	....	84	62	60	513,380	447	487	— 8.2	2,789,435	3,046,232	....	1	1	26	28	3	9	9	138	159	164	39	45	41
Dist. 3: Upper Gulf	60	6	2	58	1	127	136	175	743,250	1,003	1,062	— 5.6	6,676,701	7,073,662	1	....	....	33	34	15	6	1	247	269	269	112	129	151
* Gulf of Mexico	....	....	....	1	....	1	....	1	6,224	6	5	+ 20.0	44,159	50,036	....	....	....	....	....	1	....	....	2	3	3	1	....	6
Dist. 4: Lower Gulf-S.W.	47	9	6	57	....	119	117	133	573,478	839	877	— 4.3	4,380,648	4,648,196	....	....	1	30	31	10	6	2	237	255	289	85	87	67
* Gulf of Mexico	....	2	....	....	....	2	2	1	20,508	12	7	+ 71.4	116,229	69,817	....	....	....	....	....	....	....	....	....	....	1	3	3	2
Dist. 5: East Central	7	....	....	11	....	18	11	27	78,957	96	149	— 35.6	426,079	499,316	....	....	....	9	9	1	1	1	64	67	77	20	8	11
Dist. 6: Northeast	53	8	4	30	....	95	90	74	490,568	641	523	+ 22.3	3,479,537	2,777,909	1	....	....	17	18	3	2	3	136	144	142	64	74	67
Dist. 7-B North Central	128	....	7	141	....	276	171	232	941,138	1,607	1,845	— 12.9	5,467,261	6,485,554	8	....	....	97	105	53	....	6	524	583	695	106	121	112
Dist. 7-C West Central	63	....	2	30	....	95	95	106	503,830	716	742	— 3.5	3,220,444	3,357,380	....	....	....	18	18	26	....	5	190	221	185	80	95	106
Dist. 8: West	369	....	4	69	5	447	379	432	2,248,426	2,968	2,456	+ 20.8	14,558,830	12,540,156	14	....	1	41	56	48	1	3	253	305	325	376	390	297
Dist. 9: North	247	2	7	200	13	469	365	426	1,330,201	3,029	3,099	— 2.3	7,937,051	9,136,774	5	....	1	106	112	42	....	5	658	705	647	231	241	202
Dist. 10: Panhandle	109	2	22	22	....	155	119	143	604,995	854	811	+ 5.3	3,371,685	3,102,019	....	1	1	6	8	6	11	5	49	71	73	132	117	97
Utah	12	....	....	8	....	20	25	12	105,037	112	84	+ 33.3	646,206	397,463	1	....	....	5	6	7	....	2	44	53	57	58	54	33
Washington	....	....	....	1	....	1	1	....	4,326	3	1	+200.0	16,329	7,493	....	....	....	1	1	....	....	....	3	3	1	1	1	....
West Virginia	7	....	41	10	....	58	57	49	145,212	342	399	— 14.3	923,950	1,045,674	....	....	1	1	2	....	....	6	6	12	.....	170	175	185
Wyoming	31	....	7	50	5	93	75	71	377,218	437	515	— 15.2	1,851,194	2,389,050	2	....	2	28	32	10	....	4	124	138	135	101	96	108
Total United States	2,481	70	325	1,887	115	4,878	4,284	5,181	19,364,839	30,954	34,075	— 9.0	127,896,271	138,541,548	73	6	14	935	1,028	472	70	129	5,901	6,572	7,159	4,983	4,930	4,775
Total Western Canada	210	....	13	62	1	286	359	363	1,259,236	1,742	1,505	+ 15.7	8,135,559	7,169,613	....	....	....	....	....	....	....	....	....	.....	.....	220	219	230

* Gulf of Mexico wells are included in their respective district totals.



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There's not a single machine in the shop at the Oil Center Tool Company that thinks for itself.

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But, some of the machines come pretty close to being self-contained "brains."

"Hand made" products no longer denote perfection. Uniformity, quality and specialization are better achieved on the automatics.

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The most modern, the most efficient in tools, automatic and otherwise,—that's another reason for the supremacy of O-C-T products.

Precision, specialized well control equipment isn't turned out by hand . . . it's turned out with machines faster than the hand.

Oil Center Tool Company got along pretty well back in 1927 with one milling machine, a drill press, shaper and two engine lathes in an 18 x 20-foot shop.

Today, the company's plant occupies more than 55,000 square feet of floor space with all facilities covering 13½ acres. That's only temporary, of course. Expansion is always under way.

O-C-T machines, like O-C-T products, are specialized and versatile.

The little ones turn out big jobs and the big ones sometimes turn out little jobs.

O-C-T machines take raw, dull-looking hunks of iron and steel and convert them into gleaming pieces of well control equipment that can handle the toughest, the most complicated assignments.

For example, two recent additions to the machine shop cost about $100,000 each.

Their purpose?—Mass production that still imbues the product with an individual personality.

The units can be preset to do specific chores, automatically boring huge castings; boring vertically or at angles; boring tapered holes, holes the same size—all with super speed.

The nerve center of these robot giants is a complicated case of delicate electronic equipment.

In the midst of an automatic boring job, these machines can be halted, switched over to manual control to turn out an emergency job, and then placed back on its original work with no time lost in resetting controls.

Ultra modern machine shops is one reason why O-C-T continues to set production records.

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And the O-C-T formula of advanced machines plus skilled workers results in the precision needed . . . in volume . . . by the oil industry.

At O-C-T they can not use aged machines to be first in the machine age.

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THEY COST O-C-T nearly $100,000 each, but these two new automatics will get emergency jobs to oil operators days earlier.

WHY DOES ONE MUD VALVE SELL BETTER THAN OTHERS?

On the really tough jobs (formation fracturing, cementing, etc.) Cameron Flex-Seal Mud Valves are virtually standard equipment. For normal service also Flex-Seals have consistently outsold all other mud valves. Now the Type "R" Flex-Seal is bringing even more benefits to operators in every oil producing area. You know the following reasons if you have made a comparison with other mud line valves:

1 Longest Wear

The Type "R" Flex-Seal has the longest wear and lowest maintenance of any mud valve. Separate carburized wear rings and tough new gate packer are both many times larger than competitive valves. In most repairs you need only replace the inexpensive packer. Compare these parts with other mud valves — there *is* a difference.

2 Easiest Repair

Simply unscrew four thread protecting extended cap nuts — packer and wear ring lift straight out as a unit. Integral welded subs and bonnet cap make misalignment during repairs impossible. If a sub is sand cut, it may be separated and replaced without buying an expensive body. Gate replacement requires no special fixtures, no intricate thread timing.

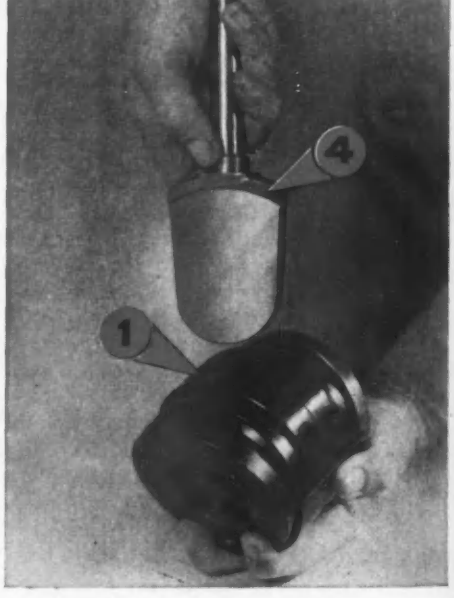
3 Easiest Operation

Convenient tiller wheel gives bump operation for extra easy opening and closing. Ballbearing stem nut and stem threads are packed with grease by Alemite fitting. Grease is also injected in upper body void to retard hardening of sand, mud or cement allowing gate to retract easily to open position.

4 Gate Prevents Packer Flow

Flex-Seal has the only mud valve gate with a shoulder to prevent flowing of resilient packer and to prolong its life. Heat treated gate and stem are one solid forging. Upper section indicates open or closed position, also tells amount of wear in packer. Stem packing is oversize resilient lip seal which is mechanically energized when gate is in open position.

For safe, economical service, count on Cameron Type "R" Mud Valves — finest in the oil fields.



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Digital Computers Can Help Geophysicists

The digital computer can be of use in the correlation of seismic data, the correlation of geologic data, different types of geological data with each other, or different types of geophysical data with each other.

By THOMAS J. BEVAN and PAUL W. FULLERTON
Southwestern Computing Service
Tulsa

THE DIGITAL computers are often referred to as magic brains. Enthusiastic writers predict that such machines will be able to make the type of decisions made by company executives; decisions of the type which we usually classify as judgment. In the geophysical field we might follow this line of thought and imagine a machine having fed in the gravity data, magnetic data, seismic records, lease costs, production records and overhead—then, with a ringing of bells and flashing of lights out will come the location for the wildcat and the net profit to be expected from the venture. Such dreaming is pleasant and necessary, but it is not the purpose of this paper. Those closely familiar with present day computing machinery would be the last ones to call them magic brains.

There has been much less information spoken and published on what actually can be done with the machines which are available today, and how to go about it. At the risk of being too elementary, it is the purpose of this discussion to point out operations which are being applied to geophysical data today and the lines of thought helpful in the development of further applications.

The applications of the machines to the present calculating procedures will be discussed first. Modifications of these procedures to improve the quality of the end product will then be taken up.

In the consideration of applying digital equipment to operations which are now being done with the desk calculator, there are certain tests which are useful. Here are four of these tests, any one of which may justify the use of the machines.

1. Repetitive use of data.
2. Complex calculations.
3. Value of "superhuman" accuracy and consistency of treatment.
4. Value of speed.

First consider whether or not the basic data is to be used in more than one simple calculation. It is quite obvious that a desk calculator gives an answer for a single operation by punching one key for each digit in the basic data plus probably one more punch to indicate the addition, subtraction, multiplication or division. In order to introduce these data into punched cards the same amount of effort is necessary, in fact the work is usually verified to eliminate copying errors, which is a duplicate punching operation.

If the data is to be used once and never again the machine approach has little merit. However we must consider carefully before we discard the machine approach even on this basis. For example, the calculation of the elevation factor in gravity work is a simple multiplication. Quite often after a survey is well under way it appears that a slightly different factor should have been used. Here is a repetitive use of data which might not have been anticipated. When such a situation arises, if the work is in punched card form, a recalculation of the data is quickly and easily obtained at a remarkably low cost both in time and money as compared with the hand operation. In seismic operations there may be a similar situation upon the acquiring of additional information on velocities or weathering corrections after the survey is under way. A punched card deck which includes basic data, reflection times, and first breaks for each shot point makes it possible to obtain such rework results in hours rather than weeks, with considerable saving in expense. It is well known how common it is in geophysical work for parameters to be changed and computing techniques to be revised. Therefore if there is a reasonably remote chance that the data may need to be reworked, the application may be given a passing grade on this test.

While the desk calculator may give strong competition to the machines for single calculation, that is, multiplication, division, subtraction and addition, if the computing requires several of these operations on the basic data then the machines become considerably more economic, faster and more reliable even for a one time operation.

Figure 1 is an example of a power series used in gravity residual analysis. To substitute in values for the coordinates x and y and grind out the answer to this expression on a desk

calculator requires about 15 minutes with no guarantee of accuracy. On one calculator the answers are produced at the rate of 25 per minute. In the hand operation the process is completely uneconomic, the cost including reasonable checks running at least 15 to 20 times the cost of the machine operation. It can be considered a safe rule that *all complex* calculations are faster and more economic when performed by electronic equipment.

The next consideration is the value of the "superhuman" accuracy of the electronic calculators. There is no doubt that once a routine problem is set up and checks properly provided, that the machine process can be made practically error free. Fortunately, random errors do not seem to be a problem with the equipment. Most of the machine breakdowns are caused by vacuum tube failures, which in most cases, can be made instantly recognizable. There is no doubt that, when carefully programmed, the machine is far superior to the human so far as accuracy is concerned. Along this same line of thought we also wish to point out the advantage of the uniformity of treatment provided by the machine routine. The machine applies exactly the same process to each case fed into it, unless instructed to the contrary. This consistency of treatment involving such simple operations as rounding of figures, estimation of best fitting lines and uniformity of datum planes can be of considerable value in keeping jumps out of the results, which occasionally occur when adjoining data are computed by different people. In an industry in which computing errors and oil fields are indicated by the same type of anomalies, there is little need to point out the importance of both these accuracy features.

In the consideration of speed the gap betwen the time required for hand calculating and machine calculating for a one time run may not be as large as anticipated. Although the actual calculating is done at fantastic speeds, time is required to key punch the data. In seismic work, the data will have to be read off a record and written on some type of form practical for a key punch operator to copy. There may occasionally be delays because of machine breakdowns. All these factors tend to offset to a certain extent the high speed of the actual numerical operations. There are, however, even with simple operations, some advantages to be gained, in the form of the output of the data. The flexibility of the listing machines makes it possible for the results to be provided in list form sorted according to shot point, or station number or any desirable arrangement. Duplicate lists can easily be provided or the answers may even be printed on labels which can be attached directly to the seismic records.

As mentioned previously, the advantage of the machine increases as the complexity of the calculation and particularly presents itself when a rework operation is required. Quite often a discovery well sets off a land play causing a frantic effort to review all of the seismic data available. If a rework of the records is required and the basic data is in punched card form the necessary information may be available to the land department before they buy their leases rather than after, as is far too often the case.

DEFINITION OF RESIDUAL GRAVITY

$$g_r = g_o - R$$

Where:

$$R = C_{00} + C_{10}x + C_{20}x^2 + C_{30}x^3 + C_{01}y + C_{02}y^2 + C_{03}y^3 + C_{21}x^2y + C_{12}xy^2 + C_{11}xy.$$

and

$R \equiv$ Regional gravity.

$x, y \equiv$ Horizontal Coodinates.

$C_{ij} \equiv$ Constants to be determined.

$g_r \equiv$ Residual Gravity.

$g_o =$ Observed gravity, at station whose coordinates are x, y.

FIGURE 1—If a calculation requires the combined operation of multiplication, division, subtraction and addition on a broad scale, the advantages of the electronic computer become more obvious.

It can be concluded then that if in any of these four tests the machine shows an advantage over the desk calculator, it should be applied to routine calculations.

Thus far the computing machine has been considered as a sort of super desk calculator. Now consider the modifications in the computing routines themselves, which the machines have made practical.

There are many instances in geophysical work in which a method of computing is approximate because the labor necessary to obtain a more exact answer is not considered justified. For example, referring again to the gravity elevation factor problem, if one is doing the work by hand he would not consider working a job on several different factors, or making a statistical analysis by cross-correlation for the best factor to use, because of the sheer labor of performing all the multiplications. Yet ideally this approach has advantages. The first question then, in considering our computing processes, is to ask what is the *ideal* method of treatment, which makes use of all the data available, regardless of the complexity of the mathematics. Quite often a machine operation is just as cheap and fast for several multiplications as it is for one. A straight line will no longer be fitted to a set of points if it is known that a second degree curve would give a better fit; a curve function will no longer be used if it is known that in nature a step function is what should have been used; a constant velocity will no longer be used over a large area if well data indicates such is not the case. These are the type of questions that the geophysicist can answer. These are the type of problems which the computing machines can handle economically, when often they are completely impractical for hand calculators. The geophysicist should search carefully through all his present computing systems for short cuts which were put there for expediency rather than for theoretical reasons. The release of the geophysicist from routine calculations should give him more time to concentrate on these basic problems which require *true* brain work distinguishing his capabilities from that of a machine.

He may not be able to decide on a unique solution for some problems, in which case he has available to him the alternative of calculating answers for several different methods or parameters. Often the extra data can be economically produced even though it is seldom used. For example, one can calculate the seismic data for several velocity functions or several weathering procedures if for no other reason than to prove that, at critical points, the seismic high is independent of these computing uncertainties.

In elaborating our computing methods there is naturally a limit beyond which the machine calculations will become unreasonably slow or expensive. The geophysicist has little chance

of telling where this boundary line is. At this stage it is time to call in a specialist on computing. If the geophysicist can state his problem clearly, consultation with a mathematician familiar with the machines should produce a method which is practical and economic.

Unfortunately there are far too few machine experts with engineering backgrounds available. The operation of digital equipment is a specialized field and becoming more so as the machines become larger. The larger oil companies in most cases have Rand punch card set ups which were designed primarily for accounting work and, in most cases, are run by accountants who have little interest or aptitude for engineering applications. Many research laboratories have their own equipment but it is usually not available for routine day to day operations nor are their staffs experienced in applying the machine to repetitive day in and day out applications. The most useful help towards bridging this gap between the man with the problem and the man with the machine is found in the computing service bureaus.

Those that specialize in computing work can save a tremendous amount of false starts and wasted effort. Operation of the computing machinery is becoming a highly specialized operation and there are many "tricks of the trade," which no amount of reading or study can provide the geophysicist. The service bureau will probably become more important in the computing field as the larger computers become available. It is paradoxical, that the larger the machine and the more it approaches the complexities of the human brain, the more brains are required to operate it. In fact, it appears that a good rule of thumb is to increase the budget for a staff the same amount that the budget is increased for machine rental.

Presently available computing equipment and that which is to appear has two common characteristics: *high speed* and *high cost*. The high cost is offset by the high speed, *providing* the machine is kept busy. In order to get the necessary versatility the larger machines are necessary for many problems. These same large

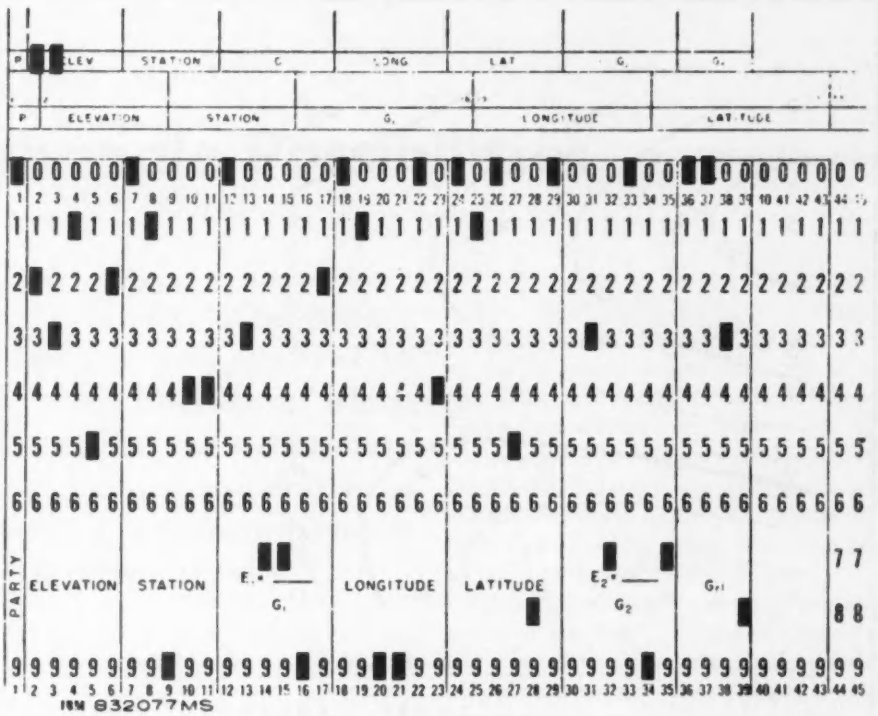

FIGURE 2—A data card showing the elevation, observed gravity, latitude and longitude. A fringe advantage of the punch card recorded data is the fact that little storage space is required.

machines are also more expensive and require more "grist for the mill" in order to be economic.

There are at present many calculators which are actually in use only a few days of each month but whose value for these peak loads justify their extra expense during their idle time. The more elaborate equipment cannot be so easily justified. In many cases it will probably be years before smaller organizations have worked up enough applications from their various departments to justify the installation of machines costing $200,000 or more.

The calculation of a rather complex weathering function was one of the first geophysical applications set up about two years ago. The first breaks, reflection times, elevations, shot point numbers and other basic data are written down for each record by the client. The data is key punched, verified, the weathering calculated, the velocity functions applied and the results listed, along with check information. Results are also listed on special labels which can be attached to the seismic records.

This work has been handled on a daily basis for almost two years without a single undetected error. As an illustration of the efforts made to keep these errors out we will point out some details of the procedure. In the first place all the data was verified after being punched in the cards. A detailed procedure was laid out for the machine operators in which there were various check points in the operation. The actual calculations were performed twice and the answers checked against each other as a guard against random errors.

In addition, test cards were interspersed through the deck in which the answers had been previously calculated. In case of a machine failure conflicting answers would appear on these test cards and stop the machine. Special signals were generated by the machine to indicate those cases whose range of values fell outside the case set up for solution. Finally, as an overall test of one calculator, a special board was wired which requires the machine to perform about 100,000 calculations within a few minutes time, arriving at a pre-punched answer. By using this panel several times a day a careful check is kept on the working condition of the calculator. These procedures are cited as an illustration of how the "superhuman" accuracy is attained and to illustrate

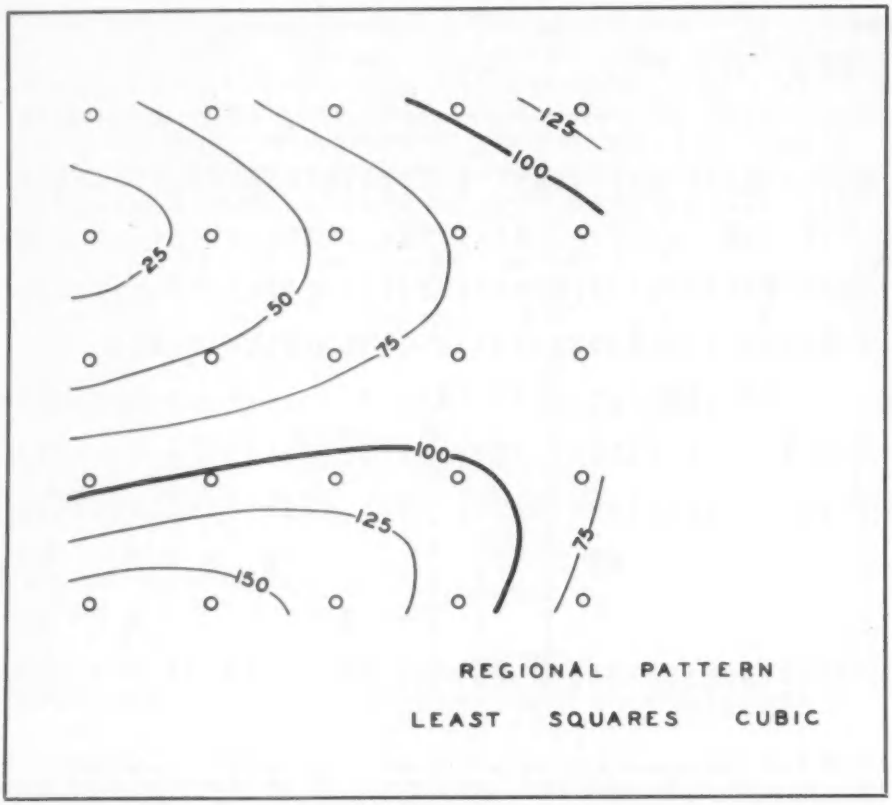

FIGURE 3—The analytical description of curved surfaces as illustrated in connection with gravity work, is also applicable to subsurface mapping, to seismic velocity maps, and other data which involve a description of datum values over an area. It is, in a sense, a method of getting an unbiased job of contouring or the best fitting smooth surface close to or through an array of points.

the necessity of careful planning in order to attain such reliability.

In gravity work the fitting of a curved surface to the gravity regional by the least squares power series approach has been applied for about the same period of time in a routine fashion. Recently the gravity operation has beeen augmented to include the calculation of the elevation corrections and addition of elevation and latitude corrections to the observed gravity. In this instance the basic data card, (Figure 2) one for each station, shows the elevation, observed gravity, latitude and longitude. A few drawers of cards represent a years data, available for rework or relisting in a few hours time. Residual gravity calculations based on grid point systems have also been handled. One company obtains a list of 10 different residual values for each point.

They have done some work with cross-correlation techniques. Oliphant and Fullerton (1954)[1] have correlated electric logs from core holes in an effort to correlate logs which otherwise were very difficult to use. The results were used to augment visual correlation. Similarly, this cross-correlation technique has been applied between gravity residual values and elevation in order to detect an association between gravity anomalies and topography.

All of these operations are relatively simple and straight-forward but they illustrate the fact that applications of the equipment are not something in the dim future but are something that can be taken advantage of today.

In the estimation of oil field reserves, empirical curves are often developed which can be used as a guide in the prediction of future production. The method of developing a family of empirical curves to be used as a "guide to good guessing," is one which is made practical by the machine approach, since the machine can calculate answers rapidly for many different parameters. The finding of the best matching curve can also be done statistically, the machine giving not only the best fitting curve to the data but also an index as to the reliability of the answer.

In gravity work the field is wide open. Very little *quantitative* work has been done in the interpretation of gravity maps because of the labor involved and the uncertainty of densities. The machine approach should afford an opportunity to get a family of solutions for various density distributions. Probably, in many cases, the density distribution will turn out to be of less importance than anticipated so far as the location of the subsurface anomaly is concerned. Bateman[2] has given an expression for the density distribution on a surface at any depth, for a given gravity field. With depth as the parameter, the gravity map can be computed in terms of relief at various depths. The same techniques are applicable to magnetic data.

There are, of course, many more elaborate applications that can and will be worked out but as stated at the beginning these are beyond the scope of this discussion.

Summarizing then, it is suggested that the most practical approach to the use of digital computers can be arrived at, first by searching for applications in which the computer does essentially the same work that is now being done by hand but for one of the four reasons given shows an advantage over the hand method. This will have the advantage of getting the program started and give the geophysicist an idea of what can be expected from the machines. By the gradual modification of present computing techniques, and by adding operations to the machines more or less a step at a time, many pitfalls can be avoided which can easily occur if too elaborate a program is laid out all at one time. It is believed that once the industry begins to make these first relatively simple steps towards the application of computing machines to geophysical work that rapid advances and improvements will appear in the interpretation and handling of geophysical data. If this discussion can influence some to make these first steps it will have accomplished its purpose.

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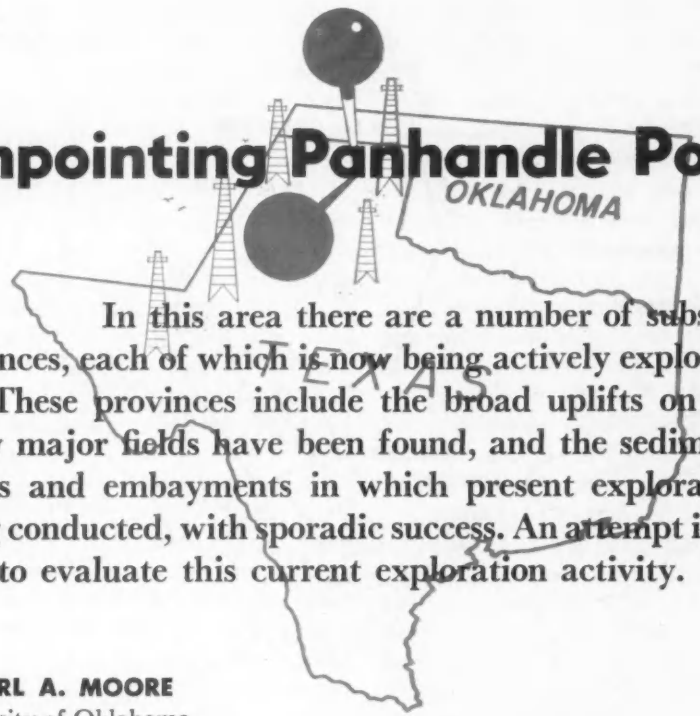
Pinpointing Panhandle Possibilities



In this area there are a number of subsurface provinces, each of which is now being actively explored for oil. These provinces include the broad uplifts on which many major fields have been found, and the sedimentary basins and embayments in which present exploration is being conducted, with sporadic success. An attempt is made here to evaluate this current exploration activity.

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OIL IS BEING sought, and found, in the sedimentary basins today, these down-warped segments of the earth's crust, into which have been deposited great thicknesses of sedimentary rocks. Each basin has had its own particular geologic history, yet most basins have developed along one of a few lines. In order to present the oil production of this area, and to attempt to point out where oil deposits may be found, a short summary of basin mechanics will be presented.[1]

Typical Asymmetrical Basin. A typical asymmetrical basin has a mobile borderland on one side (Figure 1), flanked by the deepest part of the basin. It is on the borderland side that the most complete geological sections are to be found. For example, in the Anadarko basin, the borderland is the Wichita Mountains, and the deepest part of the basin lies just a few miles north of the mountains. The Superior Oil Company drilled its Weller well to 17,823 feet within sight of the mountains—the basement has been estimated at some 30,000 feet.

In this deepest trough, every formation is represented in maximum thickness and development. Rocks are typically basinal in character, in that they are made up largely of shales.

The shelf area, or the foreland area, lies across the basin. In the case of the Anadarko basin, the shelf area lies along the northern part of Oklahoma and extends on northward. It is along the edge of the shelf area that the hinge line, or hinge belt, is found —an area along which the relatively high dips along the basin flank change to the low dips of the shelf area.

Also in moving from the deeper parts of the basin, where all formations are thick, onto the shelf, where all formations are either thinned, or are absent, a major loss of section is apparent. The type of sediments change from the basinal types, made up largely of shales, to the shelf deposits which are normally sandstones and limestones. These shallow water deposits can be expected to be porous and permeable, and can serve as reservoirs for oil.

By definition, the borderland is a mobile area, in which the young rocks have been folded into mountains, and through which the basement rocks commonly protrude. This is true in the Wichita Mountains. As a result, most of the structures to be found in the basin will be found on the borderland side.

The foreland side, or the shelf, however, is a stable area. There have not

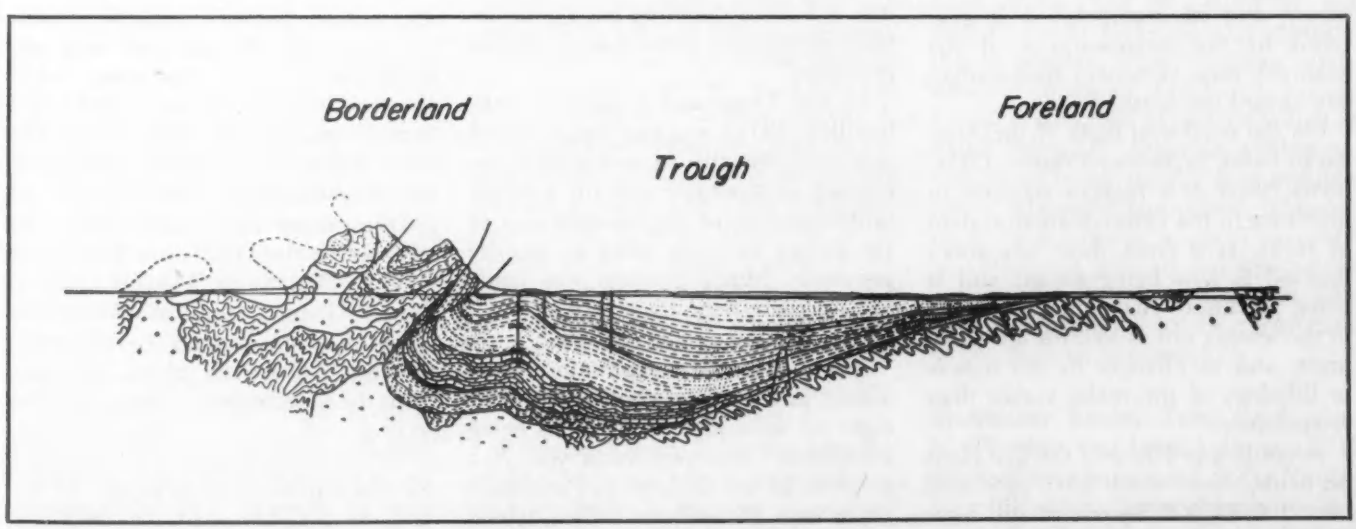

FIGURE 1—Diagrammatic cross-section of asymmetrical basin. Modified from Weeks, 1952.

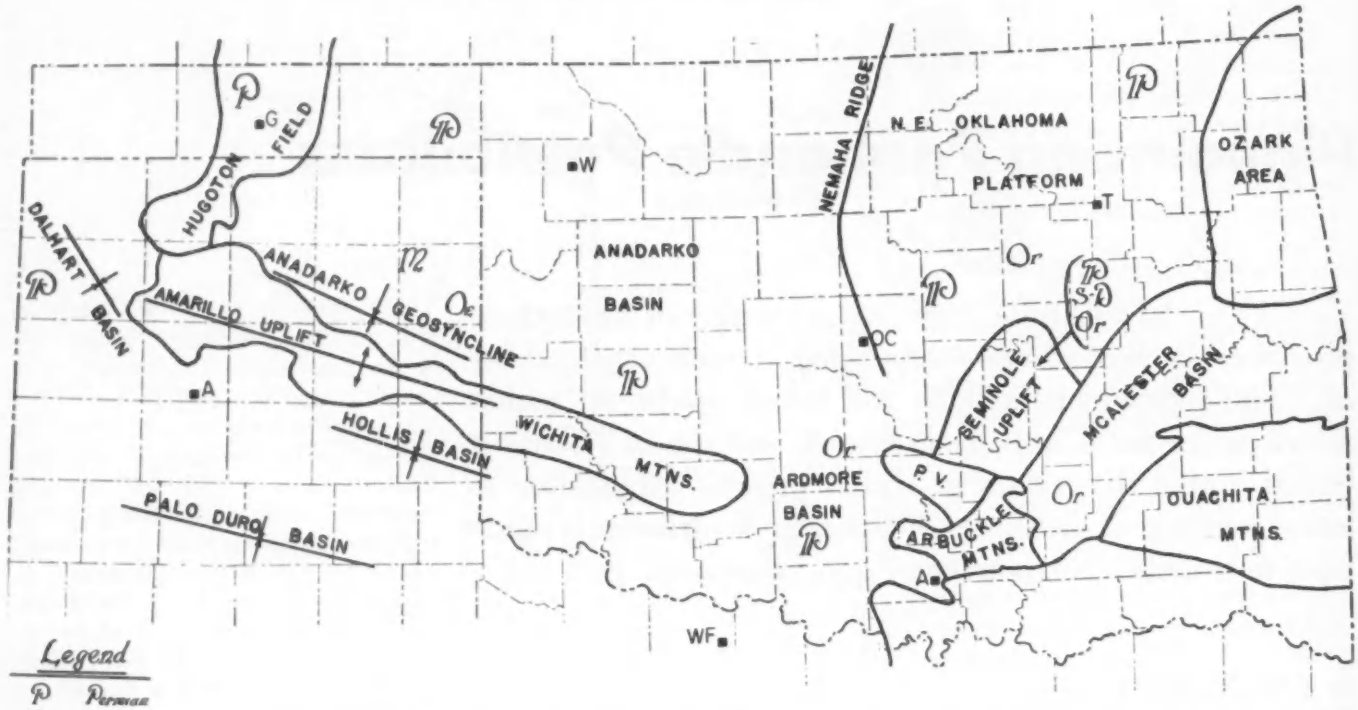

FIGURE 2—Subsurface provinces of Texas Panhandle and Oklahoma, showing age of principal production in each.

been any structural movements on this side of the basin. As a result, the shelf area is expected to have mostly stratigraphic traps, with structural traps being of minor importance. Any structures which may be found can be expected to be of small magnitude, measured in a few tens of feet, as compared with the structures on the borderland side being measured in hundreds of feet.

For example, the accumulation of oil in the Elk City field is controlled by structural uplift. On the shelf, in the Ringwood pool, the structure is minor, and oil accumulation is governed by the disappearance of the Manning zone (Chester) that wedges out toward the north.

On the northwest flank of the Anadarko basin, in Beaver County, Oklahoma, there is a marked increase in limestone in the Pennsylvanian system of rocks. It is from these limestones that oil is now being sought and is being produced. Accumulation is due to the lensing out of various limestone units, and to changes in the nature or lithology of the rocks, rather than to structure.

According to Knebel,[2] the 236 giant oil fields, those which have produced over 100,000,000 barrels of oil, have yielded 82 percent of all the past production, plus recoverable reserves. Over 70 percent of all the world's oil has been found on the stable side of the basin hinge and on the shelf. Only 30 percent has been found on the mobile borderland rim and in the deep center. These figures alone point out important factors in the study of the habitat of petroleum, and may assist in directing exploration programs for new oil.

TEXAS PANHANDLE[3]

The Texas Panhandle contains some four subsurface provinces which are important to the exploration of oil (Figure 2). Beside each named province is a letter denoting the age of the chief production from that particular province.

In the Texas and Oklahoma panhandles, 1955's exceptional record was due partially to succesfully employing all available aids for a better understanding of the complexities of the subsurface in order to localize prospects. Much progress was made toward correlating the stratigraphy of Texas, Oklahoma and Kansas.

There were 74 exploratory tests drilled in the Texas Panhandle, with eight oil wells and 13 gas wells being completed. Discovery ratio was 28.3 percent. In the Oklahoma Panhandle there were 46 wildcats drilled, which resulted in 21 new fields being discovered, for a discovery ratio of 45 percent.

The major discovery in the Texas Panhandle area during the year was probably in the Laketon area in north-central Gray County. Here Phillips Petroleum Company Troy 1-A was completed flowing 299 barrels of oil and 70 barrels of water per day through perforations below 11,000 feet, to open the first Ellenberger production in the Panhandle area. Nearest Ellenberger production is the Polar field of Kent County, 180 miles to the southeast, and the Yellowstone field of Woods County, Oklahoma, 136 miles to the northeast.

Hansford County, Texas, provided the largest number of discoveries for the year, with 11 gas wells and one oil discovery during the year. Ochiltree County contributed one gas and four oil discoveries. There were also new fields in Dallam, Hemphill, Hutchinson and Roberts counties.

One of the most outstanding discoveries in the Oklahoma Panhandle was the Northwest Mocane field in Beaver County. Initial discovery was Cabot Carbon Hodges 1, completed flowing 390 barrels of oil per day from the Checkerboard limestone. The second well in the section was completed from the Kansas City limestone for 192 barrels of oil per day. To the east, in the East Mocane field, the Pure Oil Company completed a well

in the Morrow sandstone for 6 million cubic feet of gas per day.

The primary objective horizon in the Oklahoma Panhandle has been the Morrow sandstone. All wildcats lately drilled were projected as Morrow tests, at approximately 6500 to 7500 feet, with upper zones being tested after pipe is run.

Two main exploration trends are being worked, one on each side of the Hugoton field. The most prominent of the two trends is the one on the east side that starts in north-central Hutchinson County, and extends north and northeast into Texas County, Oklahoma, and then swings northeast to join the fields located along the Central Kansas uplift. Activity in Hansford County, Texas; Beaver County, Oklahoma; and Kiowa County, Kansas, is spotted along the axis of this trend, but discoveries are being completed on both sides of the main trend area.

On the west side of the Hugoton field is a less pronounced trend starting in southern Hartley County, Texas, and extending northeast through Dallam County, Texas; Cimarron County, Oklahoma; and Morton, Stanton and Kearney counties, Kansas. This trend is generally productive in the upper Pennsylvanian rocks as well as the Morrow sandstone.

In many cases, oil and gas shows have been quite difficult to detect in the Pennsylvanian. Light colored oils, leaving little stain, and samples exhibiting faint gas odor, poor electric log surveys, caused by contamination of drilling fluid from overlying salt beds, have all combined to allow many prospective pay zones to escape observation.

Future Possibilities. It is expected that the region will continue to boom because geological conditions are better understood, and expiring leases force early drilling of prospects. Primary objective will continue to be the Pennsylvanian Morrow sandstone play, with secondary objectives being the Douglas, Tonkawa, and Hepler sandstones, and the Checkerboard and Toronto limestones of upper Pennsylvanian, both in the Anadarko basin and in the Hugoton embayment.

The shallow Permian is inviting, and it is expected to produce on local structures. Deeper production, although interesting in light of deep Ellenberger tests, is not expected to add the incentive for operators to drill the depths necessary to test this horizon. The Mississippi limestone has been found productive in Beaver County and along the northeast shelf area in Alfalfa County, Oklahoma.

Ochiltree, Hansford and Lipscomb counties, Texas; and Beaver and Texas counties, Oklahoma, will enjoy the greater part of the anticipated new exploratory drilling. Major pre-Pennsylvanian structures are delineated by subsurface regional mapping, and appear to control deposition of the Morrow sandstones, although local production is controlled by permeability and porosity conditions.

The Dalhart basin has had increased activity due to gas being discovered in the Virgil limestone of northeast Dallam and northwest Sherman counties. To the south, in Hartley County, granite wash sections prevail in the Pennsylvanian, and two or three wildcats will undoubtedly be drilled to extend small discoveries already completed in these Pennsylvanian horizons. Possibilities for deeper production are still unknown, however favorable sediments are present.

The Palo Duro basin continues to remain as a speculative basin containing the necessary sedimentary beds for accumulation, although structural trends controlling production are not yet understood. There are two oil wells and a small gas well in the basin, with eight other wells around the margins. There has been a note of pessimism in this basin, due to inadequate source beds, lack of proper structure, and wrong relation of structural growth as related to the age of accumulation.

(Editor's Note. In the spring of 1957 vigorous leasing swept the Palo Duro Basin when Shell Oil Company discovered oil in the Pennsylvanian at 6101-6123 feet in its Oldham County wildcat, Alamosa Ranch 1, 12½ miles northeast of Vega townsite. Upon completion about the middle of May, 1957, the Shell discovery well flowed 230 barrels of 40 gravity oil in 13 hours through a one inch choke after two treatments with acid. See WORLD OIL of July, 1957, Page 78.)

OKLAHOMA

Refer to Figure 2 for the location of the Oklahoma subsurface provinces, and to Table 1, for the generalized stratigraphic section of Oklahoma.

Northeast Oklahoma. The Northeast Oklahoma area includes Osage County. Total production to date is not available, but within this area is found the oldest production in the state. There are three 100-million barrel fields in this area: Cushing, Burbank, and Glenn, with a multitude of other large fields and countless smaller fields and pools.

Sandstones of the "Cherokee" group have yielded most of the oil, and the Bartlesville in particular, has produced over practically the entire area. This is the producing horizon for the fields that cover such large areas. Within the large fields, and adjacent to the large fields, are a great number of Simpson sandstone pools, mostly "Wilcox" or Bromide, which have been very prolific in production.

Both structural and stratigraphic traps are to be found in this area, in which the large stratigraphic accumulations often connect a number of the smaller structural traps. Depths are shallow, with the Bartlesville being found at a depth of 1800 feet on the east to 4000 feet on the west, and the Simpson at 2000 feet on the east, to 5000 feet on the west.

Surface geology, subsurface trends, and random drilling were all utilized in the exploration of this area. This is what Mr. Levorsen calls the "first layer of geology," wherein the surface geology reflects the subsurface geology. Consequently most all surface techniques enjoyed phenomenal success in oil exploration.

Practically all surface structures have been found and tested, hence chief future emphasis will be on locating subsurface anomalies, stratigraphic accumulations, and strand lines. These will be found in the Pennsylvanian rocks. Special mention should be made of the Reagan sandstone in this area. Long only a geological oddity, this sandstone which is found below the Arbuckle, resting on granite, is being sought as a possible future oil producing horizon. A recent study by a student at the University of Oklahoma pointed out the paleotopography of the Precambrian surface, and related it to the occurrence of the Reagan sandstone.[4]

McAlester Basin. Total production in this basin has been quite small, if the shelf area is assigned to the Northeast Oklahoma area. Much of the production has been gas from shallow

beds in the eastern part. However, Fitts pool, over 111 million barrels production, lies at the west end of the basin.

Chief producing age has been Simpson, Viola, Hunton, and lower Pennsylvanian. Oil has been found in the deeper structures, especially in the western end of the basin, while gas has been found in the shallow, sand lenses of upper Pennsylvanian, in stratigraphic accumulations in the eastern part.

Exploratory techniques were originally random drilling, and surface mapping. More recently, subsurface studies have been pushed, and geophysics has been the most successful on the deeper productive horizons. New discoveries have been in the western end of the basin below 8500 feet.

The Cromwell sandstone which produces so well on the shelf area bordering the northwest edge of the basin has failed to produce in the deeper portions of the basin, however, the future of the basin is good. Most new successes have been in the deep Simpson rocks in the western end of the basin, on deep structures. Seismic exploration, tied in to all available subsurface information will prove to be the most useful tool for future exploration.

There is presently some activity along the southern border of the basin, on the borderland side, where deep structures may be expected. Domal structures, such as the Potato Hills, are being tested.

There is much leasing activity along the north shelf portion of the basin, where stratigraphic traps are to be expected, many of which will be associated with minor structural features. Geophysics is the most valuable tool here to lay the foundation for the subsurface interpretations, and to yield data on "how deep to drill."

Seminole Uplift. This is the greatest oil-producing area in the state. In this relatively small area, there are five 100-million barrel fields: Seminole City, Earlsboro, Bowlegs, Little River, and St. Louis. Major production has been from the Ordovician "Wilcox" or Bromide, the Hunton, Bartlesville (Earlsboro), and minor production from the middle and upper Pennsylvanian sandstones. Oil has been found in structural traps in which there has been minor doming on the regional monoclinal terraces. Many of the middle and upper Pennsylvanian sandstones produce from stratigraphic traps in which these sands wedge out, or change to shale, and thus provide a trap for the oil.

Much of the oil in the Seminole uplift area is believed to have been formed essentially in place in some horizons, and to have migrated into the area from the west in other horizons. The time of accumulation of petroleum as related to the time of structural deformation is most advantageous here.

Depths are relatively shallow: 2500 feet on the east, increasing to 5000 feet on the west.

Exploratory techniques have been surface structural mapping along in echelon faults, subsurface trends, random drilling, and subsurface structure studies. In addition there were many geophysical beginnings in this area in the late 1920's and early 1930's.

The future of this area is good. Although there has been a high level of exploratory activity here for the past 30 years, current activity is still high, and new oil is being found. No additional giant pools are expected, however. The sandstones have been rather completely evaluated, but the Arbuckle limestone/dolomite is virtually untested.

Shallower Pennsylvanian sandstones will be found productive, and modern completion methods will insure production. Much oil was passed up in the 1930's in the rush to locate the prolific "Wilcox sand." These younger

TABLE 1—Generalized Stratigraphic Section of Oklahoma

Period	Epoch	Group	Formations	Southern Oklahoma Groups
Permian	Ochoan			
	Guadalupean	Whitehorse El Reno		
	Leonardian		Hennessey sh Garber sandstone Wellington sh	
	Wolfcampian	Chase	Herington ls, dol Winfield ls, dol Ft. Riley ls, dol	
		Council Grove Admire		
Pennsylvanian	Virgilian	Shawnee	Pawhuska ls	Hoxbar
		Douglas	Oread ls Endicott-Carmichael ss	
	Missourian	Ochelata	Tonkawa ss	
		Skiatook	Avant ls Dewey ls Hogshooter ls "Layton" ss Checkerboard ls Seminole-Hepler ss	
	Desmoinesian	Marmaton	"Oswego" ls	Deese
		Cabaniss	Prue ss Verdigris ls Skinner ss Pink ls Red Fork ss Inola ls Bartlesville ss "Brown limes" Booch ss	
		"Cherokee"		
		Krebs		
	Atokan		Dutcher ss Gilcrease ss	Dornick Hills
	Morrowan	"Morrow sand"	Wapanucka ls Cromwell ss	
	Springeran		Springer ss, sh	Springer
Mississippian	Chesterian Meramecian Osagean Kinderhookian		"Manning zone" Sycamore ls "Mississippi" ls Woodford sh	
Devonian Silurian		Hunton	Bois d'Arc Haragan Henryhouse Chimneyhill	
Ordovician			Sylvan sh Fernvale ls Trenton ls	
		Simpson	Bromide McLish Oil Creek	
Cambrian		Arbuckle	Arbuckle ls, dol Reagan ss	
Precambrian			Granite	

sandstones, mostly in the lower Pennsylvanian, are yielding to hydraulic fracturing methods.

Maximum success will result from detailed subsurface geological studies, mapping of sand trends and strand lines, a fuller understanding of the geologic history, and perhaps the most important, a closer cooperation with geophysics to fill in the blank spaces between wells.

Ardmore Basin. This area, in southern Oklahoma, may surpass the Seminole area for accumulative production in the near future. Stephens County, for example, is currently producing 20 percent of the oil of Oklahoma. There are three 100-million barrel fields, with a fourth area having produced over 100 million barrels of oil: Healdton, Hewitt, and Sholem Alechem, while the Golden Trend area of Garvin County has produced over 114 million barrels from a number of fields that are all essentially joined. In addition, there are two or three additional fields that are expected to reach the giant class within a few years.

The age of production is different here than in the previously described areas of Oklahoma, in that the great majority of oil has come from Pennsylvanian rocks: from the Hoxbar, Deese, Dornick Hills and Springer sandstones. Both the Permian and Ordovician are of minor importance, and the Sycamore limestone of Mississippian age, has been found productive recently.

Traps have been complex structures, often called "bald-headed" structures, in which the structures are cored with older Pennsylvanian, or pre-Pennsylvanian, rocks, and covered by the dark shales of the Deese or Hoxbar. More recently oil is being found on the flanks of these major structures wherein some of the younger formations have been eroded, and are being found productive some distance down the flank of the structure.

Depths are variable. The early wells were shallow, 3000 feet to 5000 feet. Recent activity has gone below 10,000 feet, depending on the position within the basin, and the deepest Oklahoma production has been completed at 15,000 feet in the northern part of the basin.

There is a major bounding fault extending in a northwest-southeast direction that passes east of Marlow and west of Velma. West of this fault is largely shallow oil, while to the east, production is much deeper. The major structures such as Velma appear to be foredeep type folds which have been developed against the mountain folds that are present in the basin.[5]

Exploratory techniques have ranged from random drilling through surface mapping, geophysics, subsurface mapping, combinations of geophysics and subsurface techniques, and lease expiration. Each has had its share of success, and each will continue to be used in the future.

The future of the Ardmore basin is unlimited. It is possible to work for years and still drill a wildcat offsetting a producing well no more than 40 acres. The Springer and other lower Pennsylvanian sandstones may overlie the major structures, or may wedge out against the structures. There is considerable current activity seeking the wedge edges of these sandstones as they appear to "ring" the old structures. Production from these wedge edges may be compared to some of the salt dome production in the Gulf Coast. One well in which the dips were nearly vertical, drilled over 1000 feet of unbroken saturated sandstone.

The Sycamore limestone is a new producing horizon that is currently being exploited. Many special studies are being conducted to located the subsurface distribution of this limestone, and to learn more of the conditions under which it may be found productive.

The Simpson is a special study in itself. East of Ardmore, toward Madill, Oklahoma, the Simpson exhibits a good sand development. The new Simpson production just north of Madill is expected to approach three-quarters of a million barrels of oil per well. This good sand development extends southward into Grayson County, Texas, where the Oil Creek is being found productive. West of Ardmore, however, the Simpson loses its sands and contains mostly shales, thus limiting its prospects.

It may be pointed out that the oil possibilities of the Ardmore basin are unlimited only so long as one is able to correctly interpret the geology. But how does one explain the structure in a well that drills from the Bromide into Sycamore, drills 3000 feet of Sycamore that is normally not over a few hundred feet thick, and then drills back into the same Bromide section?

Nemaha Anticline. This province contains the largest single oil field in Oklahoma—the Oklahoma City field produced over 689 million barrels of oil, up to January 1, 1956. In addition there are two other giant fields along this structural feature: West Edmond, just over 100 million barrels from the Hunton limestone; and Tonkawa, well over 100 million barrels from Pennsylvanian and Ordovician sandstones. There are other fields that approach the giant class but may never achieve this distinction: Crescent that had the largest single well potentials of any field in the state; Garber, one of the older fields in the state; Billings, Thomas, Edmond, Marshall, to name a few.

It should be pointed out that the Nemaha anticline is not an anticline in the strict sense of the word—it is rather a trend of structures that extend in a more or less north-south direction. Some of these structures may be anticlinal ridges, others faulted anticlines, simple faults, horsts, and these faults may scissor once or twice within a fairly short distance.

Producing zones have been primarily older, Ordovician beds, on "bald-headed" structures in which these older beds have been uplifted, eroded, and covered by dark Pennsylvanian shales. In addition, lesser amounts of oil have come from the Permian in Garber, Pennsylvanian sandstones and a few limestones, considerable from the Hunton, and minor amounts from the Misener sandstone at the base of the Woodford shale. The Mississippi limestone is being found productive on the flanks of some of the structures on this major structural feature. However, the production seems to be erratic, and additional study is needed to fully evaluate this producing horizon.

The larger structures were mapped as surface features. Present emphasis is on subsurface structures, mapped with combination of geophysics and subsurface methods. Average depths are fairly shallow near the Kansas border, and increase southward toward Oklahoma City. Bartlesville sandstone and Mississippi limestone are found at 3500 feet in the north, while in Oklahoma City the upper Pennsylvanian is found at 4500 feet, Arbuckle 6000 feet, and granite at 8200 feet. Just

west of Oklahoma City, the Ordovician is found at nearly 10,000 feet.

There will be a great deal of future activity in this area. Geophysics will be needed to pinpoint the structures, and detailed subsurface mapping will delineate the stratigraphic traps, especially west of the anticline. In addition, geologic history studies and lithofacies diagrams will be utilized to study the ocurrence of sandstones, for example, in the "Cherokee" group, which may be potential sources of oil.

There is a gravimetric feature located some 20 to 30 miles west of the Nemaha anticline that extends in a more or less north-south line parallel to the anticline. This is made up of a series of anomalies which were located by gravimetric surveys. Later seismic prospecting has proved several of these anomalies to be structural, all seemingly aligned, and a number of small oil fields have ben located along this trend. An interesting feature of this particular anomaly is that the earthquake that was recorded in central Oklahoma some four years ago had its focus at El Reno, Oklahoma, which lies on this gravimetric feature.

Anadarko Basin. This has been called the most promising exploratory frontier in the state of Oklahoma. A prominent geologist stated some ten to 12 years ago that many of us would live to see as many wells drilled in western Oklahoma as have been drilled in eastern Oklahoma. Currently, however, the western Oklahoma situation is losing ground because more wells are being drilled in eastern part of the state.

Total production in the basin to date has been small, depending on whether one places fields on the east flank in the basin, or on the Nemaha anticline. So far there are no giant fields, but Elk City, in the southern part, is expected to yield over 100 million barrels ultimately.

Chief production is Pennsylvanian granite wash in the south; Ordovician on the east flank; Hunton on the north and east flanks; Pennsylvanian in the south and along the northern shelf area, and Permian in the Hugoton area and Cement area in the south.

Depths are variable, depending on the basin position. From 6000 feet along the northern shelf area to over 8000 feet along the east flank to the Ordovician, depths increase to below 10,000 feet on the southeast flank. Along the southern edge of the basin, in the deepest parts of the basin, depths are much greater, and in much of this portion, the Ordovician beds are beyond the commercial drilling depths. Elk City, for example, produces from Pennsylvanian granite wash at average depths below 9000 feet.

Structural traps will carry the oil in the southern part of the basin, along the borderland side, while oil on the shelf area to the north, will be primarily stratigraphic. It is interesting to note that oil is being found below overthrust blocks along the borderland side. Stratigraphic oil will also be found along the east flank. Nineteen fifty-five's most important field development was in the Hunton limestone at Short Junction field just southwest of Oklahoma City.

Production is currently being found as a result of intense seismic work for structures, with detailed subsurface and geologic history studies for the stratigraphic traps along the north flank. Structural uplift will assist in the localization of oil into traps along the shelf area. Surface techniques are not of much assistance in exploration as the surface rarely reflects the subsurface features.

The future of the basin is almost unlimited. Not all structures have been found or tested along the southern margin, and the southeast flank. Along the McClain County fault zone, due south of Oklahoma City, for example, the prospects are very good.

Stratigraphic traps will play an increasingly more important role as more control is gained along the northern shelf area. The Morrow sandstones and Chester limestones will prove to be commercially attractive here, as was pointed out in discussing the Texas Panhandle.

Through Beaver County extends the hinge line of Pennsylvanian rocks which separates the basinal facies from the porous shelf facies. The basin shales grade shelfward into porous limestones as the entire Pennsylvanian is thinned onto the shelf area. This provides a favorable source environment adjacent to a favorable reservoir rock. These traps in northwestern Oklahoma will be discovered by means of subsurface geology, geologic history studies, onlap relations, minor structures which will aid in local accumulations, sand trends, strand lines, porosity belts, limestone build-ups, and others. Lithofacies studies will play a major role in the exploration for these features.

Simpson prospects are currently being pursued westward across the northern shelf. In Woods County there is productive Simpson and Arbuckle at a relatively shallow depth. Complete testing should include all sediments to the Precambrian granite since the Arbuckle possibilities have not been tested.

CONCLUSION

There are many potential oil-producing areas which do not seem to fit into this province classification. These are included, however, in the total production figures.

The Texas Panhandle field, which includes a number of separate fields in Moore, Hutchinson, Carson, Gray and Wheeler counties, had produced 815,563,897 barrels of oil, as of January 1, 1956. No production data are available for the other smaller fields in the Texas Panhandle area. Oklahoma reported a total production of 7,204,127,023 barrels of oil, with no figures on accumulative gas production.

This area of Texas Panhandle and Oklahoma can be counted on to yield its proportionate share of future oil supplies. In general, the old areas are being explored for oil which was originally passed over. Modern methods of exploration, coupled with up to date techniques of well completion, formation fracturing methods, and secondary recovery, will make many of these reservoirs commercial.

In the newer basinal areas, it will require combinations of subsurface and seismic methods, with a close interdependence of these two. According to Knebel, the location of the 100-million barrel giants comes in cycles, and we are about ready for the next such field.

ACKNOWLEDGMENT

Presented before the Ninth Annual Midwestern Meeting of the Society of Exploration Geophysicists, Fort Worth, Texas, March, 1956.

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Influence of Coriolis Force On River Profiles

Coriolis transformation requires the addition of a certain acceleration in evaluating the motion on the rotating earth.

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IT IS WIDELY accepted among the students of geomorphology that various factors such as Coriolis force, centrifugal force, weathering, both mechanical and chemical, wind intensity and its direction and other factors shape the transversal profiles of a river. However there is no agreement among the students on the relative importance of these factors.

Up to the present time relatively little data have been accumulated to be of value in quantitative studies of the influence of wind, weathering, mean temperature, etc., on the shaping of river profiles. The influence of Coriolis force in shaping the transversal profiles of a river, however, has been under consideration for over 100 years, nevertheless the final quantitative evaluation of the influence of Coriolis force will depend on the detailed statistical studies of the selected river profiles and the evaluation of the role played by wind, weathering and other factors in shaping them.

Coriolis, a French physicist, was the first to make in 1840 an analytical transformation from a fixed system to rotating system that rotates with the earth.

For a coordinate system rotating with the earth, the components of the Coriolis acceleration are:

$A_X = 2w\text{Sin}\gamma \times Vy$; $Ay = -2w\text{Sin}\gamma \times V_X$; $A_z = 2w\text{Cos}\gamma VE$

Where:

W = Angular velocity of the earth
$= 0.729 \times 10^{-4}$ Rad./Sec.

γ = Geographical latitude

V_X, V_Y, V_E are the x component, y component and east component respectively of the velocity of moving object on the rotating earth.

A_X, A_Y, A_z = Components of Coriolis acceleration.

It is probable that Slovsov (1844, Russia) was the first to call attention to the earth's rotation on river banks. Tolmachoff (1932) states that speaking of Yenissei River Slovsov (1844) says: "The right shore is always (everywhere) high as it is in all Siberian rivers running in the direction of meridians; since long ago we considered this condition as the result of daily rotation of the Earth globe." Tolmachoff also states that Slovsov's book was known to Karl Von Baer of Germany who arrived at the discovery of his law, so-called Baer's law, in 1853 when he traveled down the Volga River to Astrahan. The Baer's Law states that rivers in the Northern hemisphere tend to cut their right banks more vigorously than their left banks due to the presence of Coriolis force. It is of interest to note that, according to Russell, Babinet (1849, France) was apparently among the first to advance this so-called Baer's Law.

After the publications by Karl Von Baer, numerous articles, such as by Dunker, Klockmann, Kerr (1873), A. E. Nordenskiold, Nansen and others in the U. S. and Europe appeared in the last quarter of the Nineteenth Century discussing the influence of the Coriolis force on river profiles. Somewhat later Eakin (1910) published a very detailed investigation on the influence of the Earth rotation upon the lateral erosion of streams. Bryan and Mason (1932) state that Fuller (1914) in regard to asymmetric valleys of southern Long Island and on the Martha Vineyard, Mass., declares that a full four-fifths of these valleys have a steeper western slope. In his opinion the deflection hypothesis of the early workers is the best explanation.

In spite of this preoccupation with the influence of Coriolis force on river profiles, numerous workers in the past and quite recently, such as Gulbertson (1899, 1900), Bryan & Mason (1932) Von Engeln (1942) and others emphasize the influence of weathering, temperature, etc., on the asymmetry of river transversal profiles.

During the last decade Quraishay (1943), Bates (1953), Dury (1954) and others have given their attention to the study of the influence of Coriolis force on Delta formation and meandering river valleys.

ACKNOWLEDGMENT

This note is an introduction to a research on "Statistical Studies of the Profiles of the Osage River, Mo.," which has been conducted by Brockman and Haber as students of the Dep. of Mining Eng. Missouri School of Mines and Metallurgy. However, due to their heavy class schedule, the statistical studies could not be accomplished before their graduation from M. S. M. M. in June, 1955.

The senior writer would like to thank F. Julius Fohs, consulting geologist, for his permission to publish the manuscript.

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A series on modern drilling technology—Rotary circulation systems and their inherent pressure losses.

EDITOR'S NOTE: In October, 1954 a series on this subject was initiated by the authors and four installments were published to March, 1955. Here and in the next three issues will be presented the final two chapters dealing with the circulating system. To those of our readers who would like the completed work, these articles are to be bound in book form and at the conclusion of the series can be obtained through the Book Department, Gulf Publishing Company, Box 2608, Houston.

By ROY A. BOBO and ROBERT S. HOCH
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THE HEART of the rotary drilling process, the circulatory or hydraulic* system, is shown in Figure 20. The fluid in the circulatory system performs the following primary tasks:

- Controls the relief of the vertical axial stress in the formation immediately below the bit.
- Conveys the energy required to (a) remove the cuttings or dislodged formation particles as they are formed beneath the bit; and (b) transports these cuttings up the annulus to the surface.
- Allows the separation of the drilled cuttings from the mud stream.
- Maintains the hole that has been drilled in good condition.

By virtue of its physical and/or chemical properties, the drilling fluid also accomplishes other purposes, which may or may not be important, depending upon the area and the prevailing conditions. These are:

- Prevents the entry of formation fluid (water, oil, or gas) into the well bore.
- Resists loss to porous formations or fractures.
- Reduces the slip velocity of the bit cuttings or pieces of rock dislodged from the wall of the bore hole.
- Prevents certain types of hydrous disintegration.
- Provides corrosion protection.
- Satisfies logging requirements.
- Minimizes contamination of producing formations.
- Other of lesser magnitude.

As a prelude to analysis of the various functions of the circulatory system in conventional drilling, a knowledge of relating factors is necessary. These factors include the flow properties of muds and the energy or pressure losses within the system.

Chemical properties of fluids can also influence drilling performance to a degree. The use of oil emulsion muds is an example, in which the oil phase preferentially adheres to the steel bit and the cuttings. Oil thus minimizes the tendency of the cuttings to cake between the bit teeth and ball the bit. So-called "hardness reducers" constitute another example, wherein it is reported that the adsorption by the surfaces of a solid of a substance introduced into the surrounding medium, even in very small concen-

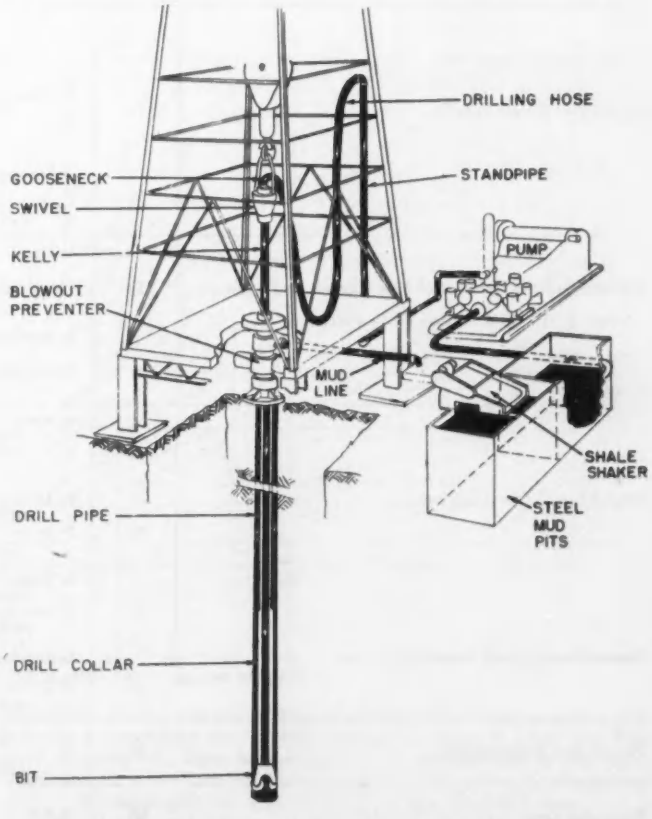


FIGURE 20—A circulatory system for a rotary rig.

* The term *hydraulics* as used herein refers not only to liquids and gases, but to suspensions as well.

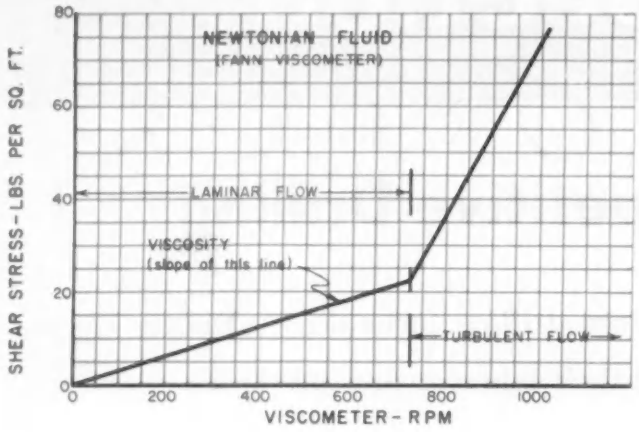
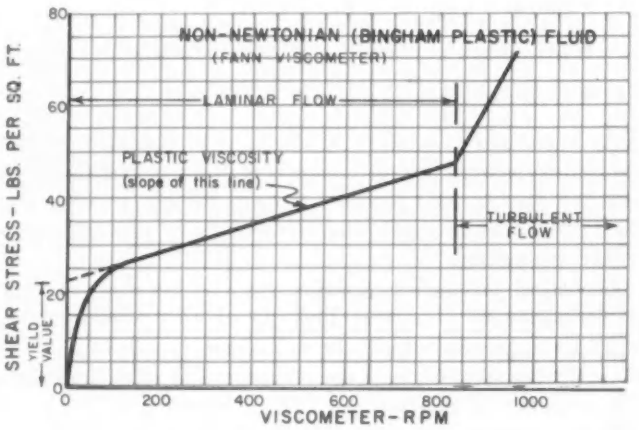


FIGURE 21



TYPICAL SHEAR STRESS-SHEAR RATE CURVES

FIGURE 22

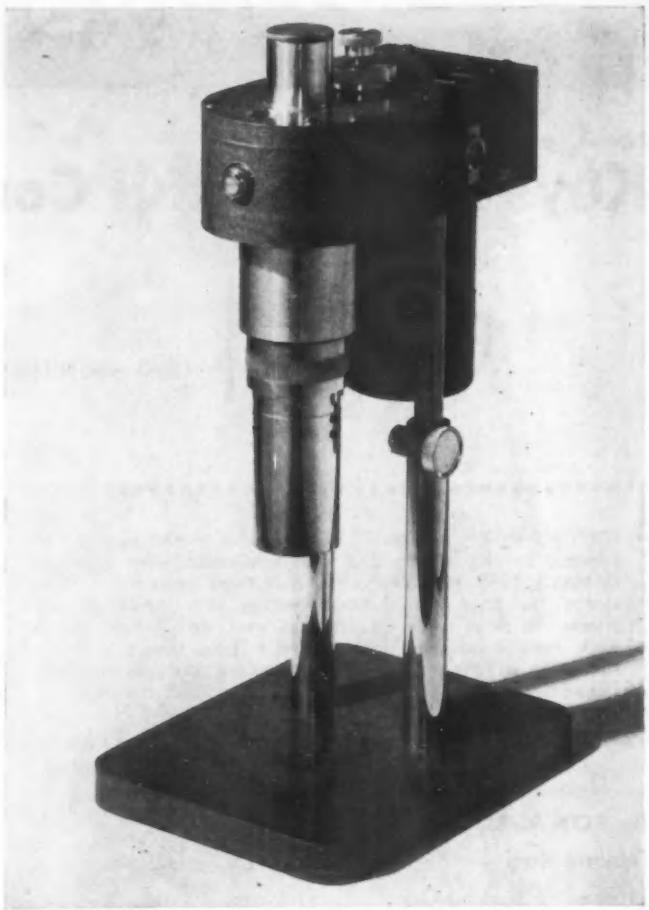
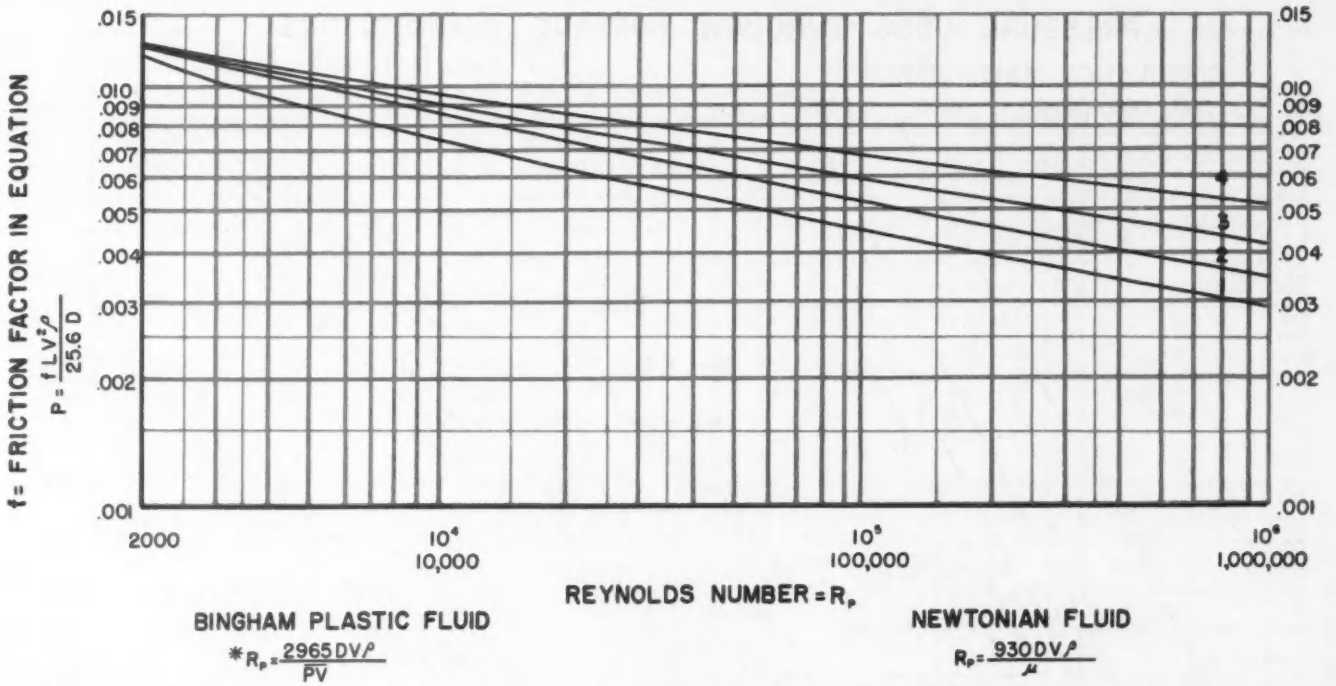


FIGURE 23—A recently developed multi-speed, rotational viscosimeter that permits ready field determination of the flow properties of the mud.

TABLE 3

DETERMINATION OF		TYPE DRILLING FLUID: Newtonian		TYPE DRILLING FLUID: Bingham Plastic
Average Flow Stream Velocity	1)	In Pipes: $Vi = \frac{GPM}{2.45\ Di^2}$		In Pipes: $Vi = \frac{GPM}{2.45\ Di^2}$
	2)	In Annulus: $Va = \frac{GPM}{2.45\ (D^2_h - D^2_t}$		In Annulus: $Va = \frac{GPM}{2.45\ (D^2_h - D^2_t}$
Critical Velocity or Condition of Flow (Laminar or Turbulent)... Note: If Vi or Va is less than Vlc, flow is laminar	3)	In Pipes: $Vlc = 2.26\frac{\mu}{Di \cdot \rho}$	3-a)	In Pipes: $Vlc = \frac{1.08.\ \overline{PV} + 1.08\sqrt{\overline{PV}^2 + 12.3\ Di^2\ YP \cdot \rho}}{\rho \cdot Di}$
	4)	In Annulus: $Vlc = 2.26\frac{\mu}{(D_h - D_t) \cdot \rho}$	4-a)	In Annulus: $Vlc = \frac{1.08\ \overline{PV} + 1.08\sqrt{\overline{PV}^2 + 12.3\ (D_h - D_t)^2\ \overline{YP} \cdot \rho}}{\rho \cdot (D_h - D_t)}$
Pressure Loss if Flow is Laminar	5)	In Pipes: $P = \frac{.000672\ Vi\ L\ \mu}{Di^2}$	5-a)	In Pipes: $P = \frac{\overline{LYP}}{225\ Di} + \frac{\overline{PV}\ L\ Vi}{1500\ Di^2}$
	6)	In Annulus: $P = \frac{.000672\ Va\ L\ \mu}{(D_h - D_t)^2}$	6-a)	In Annulus: $P = \frac{\overline{LYP}}{225\ (D_h - D_t)} + \frac{\overline{PV}\ L\ Va}{1500\ (D_h - D_t)^2}$
Pressure Loss if Flow is Turbulent	7)	In Pipes: $P = \frac{fL\ \rho\ Vi^2}{25.6\ Di}$		In Pipes: $P = \frac{fL\ \rho\ Vi^2}{25.6\ Di}$
	8)	In Annulus: $P = \frac{fL\ \rho\ Va^2}{25.6\ (D_h - D_t)}$		In Annulus: $P = \frac{fL\ \rho\ Va^2}{25.6\ (D_h - D_t)}$
Pressure Loss Across Jet Bits	9)	$P = \frac{\rho \cdot GPM^2}{12031\ A^2\ C^2}$		$P = \frac{\rho \cdot \overline{GPM}^2}{12031\ A^2\ C^2}$
Horsepower Loss	10)	$H.H.P. = \frac{P_d\ \overline{GPM}}{1714}$		$H.H.P. = \frac{P_d\ \overline{GPM}}{1714}$



1. Lowest values for drawn brass or glass tubing. (Walker, Lewis, and McAdams)
2. For clean internal flush tubular goods. (Walker, Lewis, and McAdams)
3. For full hole drill pipe or annuli in cased hole. (Piggotts Data)
4. For annuli in uncased hole. (iggotts Data)

NOTE: Flow in pipe: $V = V_i$, $D = D_i$; Flow in annulus: $V = V_A$, $D = D_H - D_T$. *Useful in Bingham plastic fluids only for determining the friction factor for turbulent flow.

CHART A—Stanton type diagram for mud flow calculations.

trations, can considerably facilitate its mechanical destruction. The effects of mud additives are outside the scope of this writing.

Flow Properties of Drilling Fluids. Drilling fluids may range from clear water to thick, viscous suspensions. These may be classified either as Newtonian or non-Newtonian fluids. Air, water, water solutions, glycerin, diesel oil, and the like are considered Newtonian fluids, because they act in laminar flow in accordance with the law of Newton which states that a true fluid exhibits a constant shear stress—shear rate relationship. In other words, New-

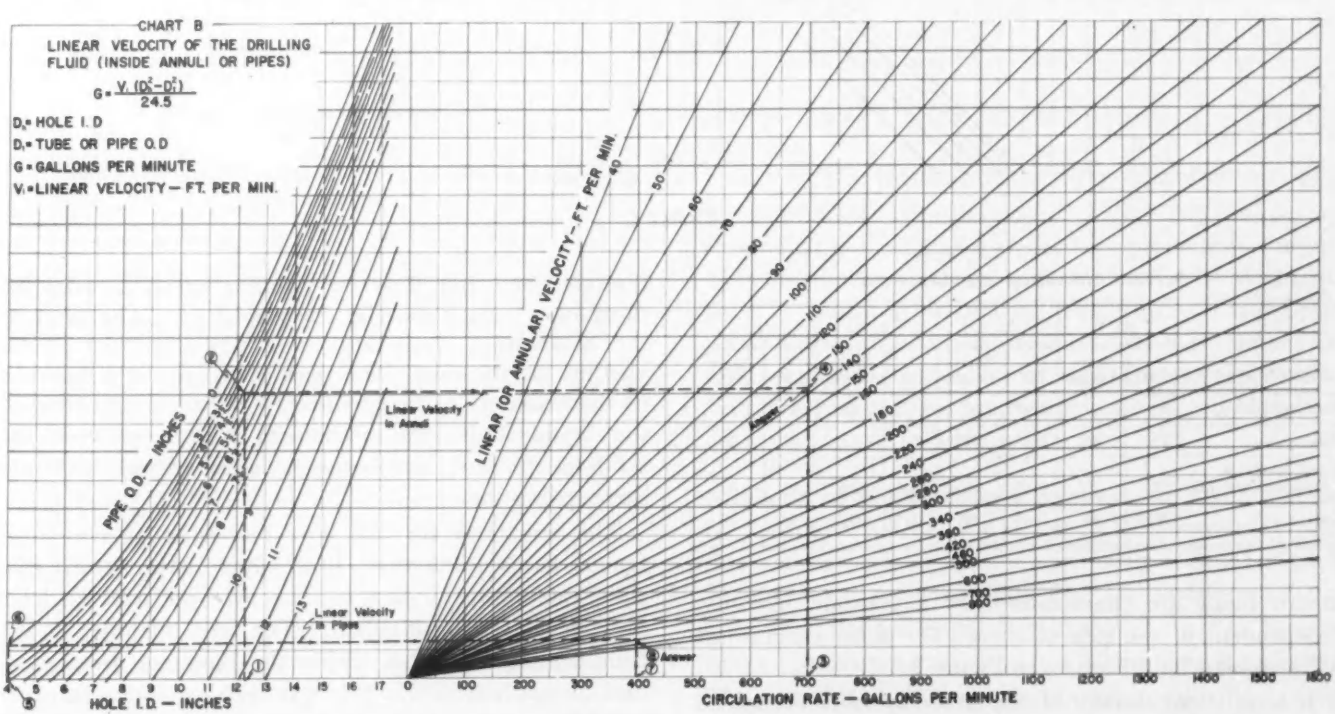


CHART B
LINEAR VELOCITY OF THE DRILLING FLUID (INSIDE ANNULI OR PIPES)
$G = \frac{V_i (D_2^2 - D_1^2)}{24.5}$
D_1 = HOLE I. D
D_2 = TUBE OR PIPE O.D
G = GALLONS PER MINUTE
V_i = LINEAR VELOCITY — FT. PER MIN.
PIPE O.D. — INCHES
LINEAR (OR ANNULAR) VELOCITY — FT. PER MIN.
Linear Velocity in Annuli
Linear Velocity in Pipes
Answer
HOLE I.D. — INCHES
CIRCULATION RATE — GALLONS PER MINUTE

EXAMPLE A—To determine the linear fluid velocity inside the annular space between a 5-inch O.D. pipe and 12¼-inch hole for a circulation rate of 700 gpm, proceed from point (1) vertically to point (2). From here project a line horizontally to the right. Then project a line vertically from point (3). The point of intersection (4) represents the annular velocity = 137 fpm.

EXAMPLE B—To determine the linear velocity inside a 4-inch I.D. pipe for a circulation rate of 400 gpm, enter graph at point (5). Proceed to point (6). From here project a line horizontally to the right. Then project a vertical line from point (7). The point of intersection (8) represents the linear velocity of the fluid 613 fpm.

CHART B

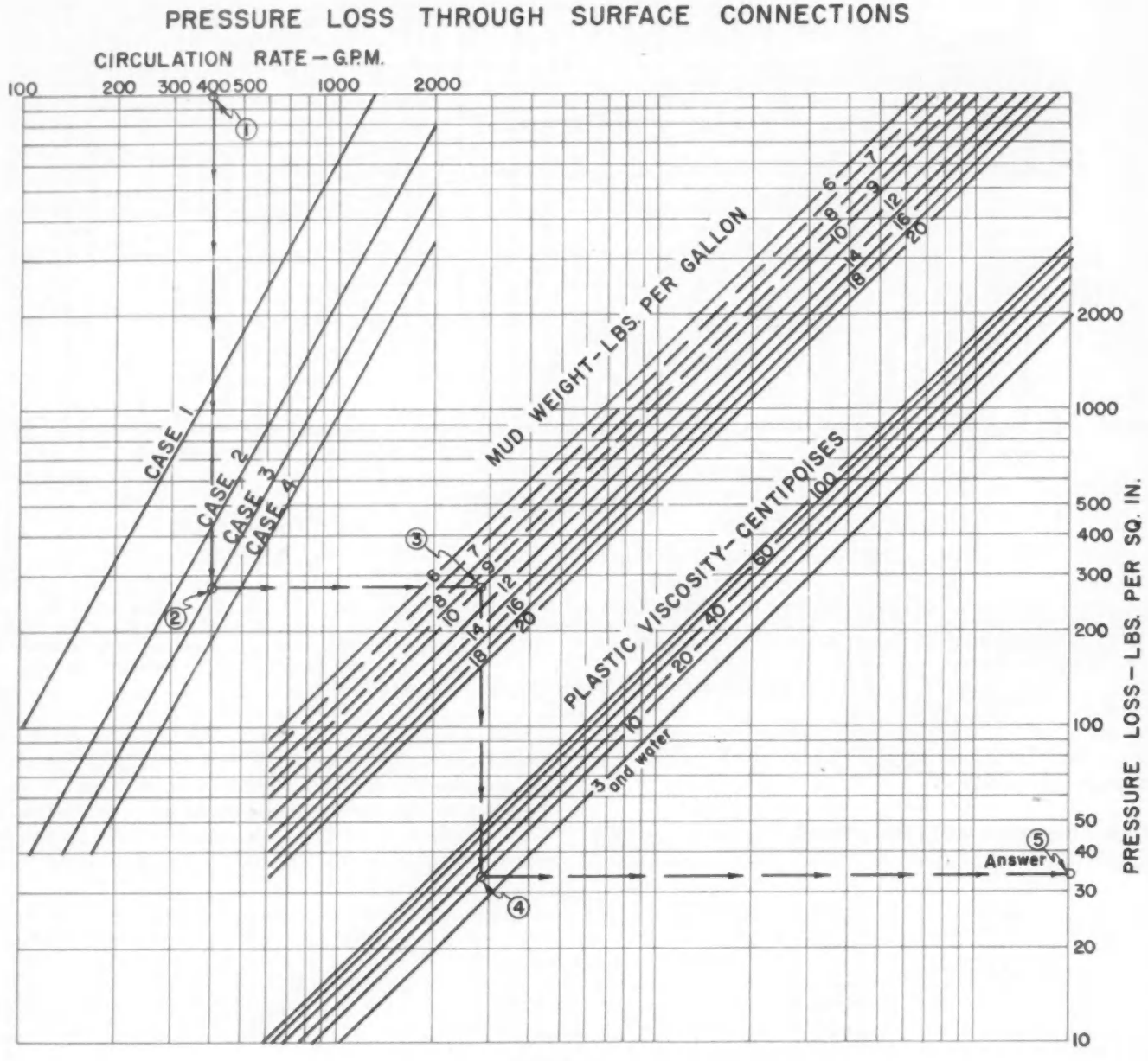


CHART C

Surface Connection Combinations

COMPONENT	No. 1		No. 2		No. 3		No. 4	
	I.D.	Equiv. Length	I.D.	Equiv. Length	I.D.	Equiv. Length	I.D.	Equiv. Length
Standpipe	3″	40′	3½″	40′	4″	45′	4″	45′
Hose	2″	45′	2½″	55′	3″	55′	3″	55′
Swivel, Washpipe, Gooseneck and Ells	2″	20′	2½″	25′	2½″	25′	3″	30′
Kelly	2¼″	40′	3¼″	40′	3¼″	40′	4″	40′

tonian fluids are characterized by a constant viscosity, independent of the rate of shear. The shear diagram of a Newtonian fluid is given in Figure 21.

If a sufficient amount of colloidal clay solids are added to water, the resulting suspension no longer behaves in laminar flow as a Newtonian fluid, but has a shear diagram similar to that shown in Figure 22. Due to the resistance to flow caused by the interparticle forces in the suspension, the shear stress-shear rate curve does not go through zero, but forms a positive intercept with the shear-stress axis, known as the yield value. The slope of the shear-stress, shear-rate curve represents the plastic viscosity of the mud. The plastic viscosity is a measure of the resistance to flow caused by the shearing action of the liquid itself, the mechanical friction between the solids in the mud, and between the solids and the liquid surrounding them.[2]

The equations for the flow properties of non-Newtonian fluids in laminar flow which have shear-stress, shear-rate characteristics, as depicted by Figure 22, have been developed by Bingham.[3] The large majority of viscous drilling muds fall within the Bingham description, and his analysis to this field has been expanded by other investigators.[4]

Unlike Newtonian fluids, in laminar flow through pipes, and in open pits, the central core of a Bingham fluid will move as a plug, outwardly to a distance where the shear stress becomes equal to the yield value. Also, at very low

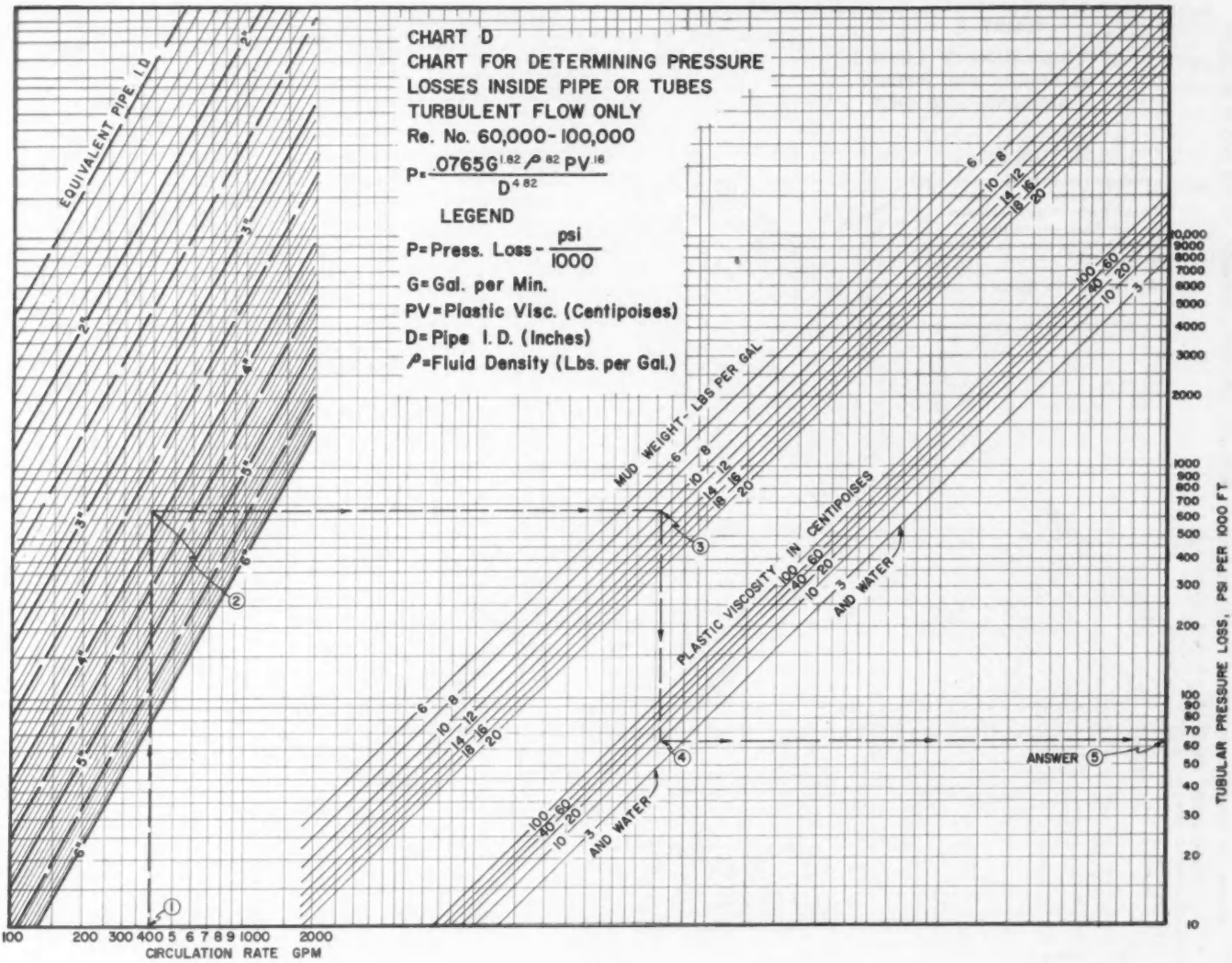


CHART D
CHART FOR DETERMINING PRESSURE LOSSES INSIDE PIPE OR TUBES
TURBULENT FLOW ONLY
Re. No. 60,000 - 100,000
$P = \frac{.0765 G^{1.82} \rho^{.82} PV^{.18}}{D^{4.82}}$
LEGEND
P = Press. Loss - psi / 1000
G = Gal. per Min.
PV = Plastic Visc. (Centipoises)
D = Pipe I. D. (Inches)
ρ = Fluid Density (Lbs. per Gal.)
EQUIVALENT PIPE I.D.
MUD WEIGHT - LBS PER GAL
PLASTIC VISCOSITY IN CENTIPOISES
AND WATER
ANSWER ⑤
TUBULAR PRESSURE LOSS, PSI PER 1000 FT.
CIRCULATION RATE GPM
100 200 300 400 5 6 7 8 9 1000 2000

CHART D

Table of Equivalent Diameters

O.D. and Description of Various Sizes and Types of Drill Pipe	Equivalent Diameter, Inches
2⅜" 6.65 lb., Regular API 1" I.D.	1.55
2⅜" 6.65 lb., Slim Hole 1¼" I.D.	1.72
2⅜" 6.65 lb., Internal Flush 1¾" I.D.	1.81
2⅞" 10.4 lb., Regular API 1¼" I.D.	1.89
2⅞" 10.4 lb., Slim Hole 1½" I.D.	2.11
2⅞" 10.4 lb., Xtra Hole 1⅞" I.D.	2.14
2⅞" 10.4 lb., Internal Flush 2⅛" I.D.	2.15
2⅞" 6.5 lb., Internal Flush 2⅜" I.D.	2.25
3½" 13.3 lb., Regular API 1½" I.D.	2.455
3½" 13.3 lb., Double Stream Line 1 13/16" I.D.	2.56
3½" 13.3 lb., Slim Hole 2⅛" I.D.	2.68
3½" 13.3 lb., Full Hole & Xtra Hole 2 7/16" I.D.	2.74
3½" 13.3 lb., Internal Flush 2 11/16" I.D.	2.76
4" 14.0 lb., Double Streamline 2⅜" I.D.	3.18
4" 14.0 lb., Slim Hole 2 9/16" I.D.	3.23
4" 14.0 lb., Full Hole 2 13/16" I.D.	3.29
4" 14.0 lb., Internal Flush 3¼" I.D.	3.34
4½" 16.6 lb., Regular API 2¼" I.D.	3.54
4½" 16.6 lb., Double Streamline 2 11/16" I.D.	3.65
4½" 16.6 lb., Slim Hole 2 11/16" I.D.	3.65
4½" 16.6 lb., Full Hole 3" I.D.	3.76
4½" 16.6 lb., Full Hole 3 5/32" I.D.	3.79
4½" 16.6 lb., Xtra Hole 3¼" I.D.	3.83
4½" 16.6 lb., Internal Flush 3¾" I.D.	3.82
5" 19.5 lb., Xtra Hole 3¾" I.D.	4.33
5½" 21.9 lb., Regular API 2¾" I.D.	4.40
5½" 21.9 lb., Full Hole 3 13/16" I.D.	4.66
5½" 21.9 lb., Full Hole 4" I.D.	4.70
5½" 21.9 lb., Internal Flush 4 13/16" I.D.	4.80
6⅝" 25.2 lb., Regular API 3½" I.D.	5.52
6⅝" 25.2 lb., Full Hole 5" I.D.	5.88
6⅝" 25.2 lb., Internal Flush 5 29/32" I.D.	5.96
For Drill Collar Bores	Same as Bore I.D

velocities, plastic muds are for all purposes in a state of plug flow.

Within the past few years, a multi-speed rotational viscosimeter has been developed (Figure 23) that permits ready field determination of the flow properties of muds.[5] This instrument is extremely useful in the chemical treatment of muds, in calculating pressure drops and horsepower losses, in predicting downhole pressure surges from running of drill pipe and casing,[6] in designing surface mud systems, and for other applications considered too difficult prior to its advent.

Analysis of Rig Hydraulic System. An analysis of the rig hydraulic system may be made by determining pressure and horsepower losses in each of its component parts. Two ways are provided to do this. The first is by calculations from formulae given in Table 3, with a Stanton type of diagram Chart A for use where flow is turbulent. The second, and by far the most convenient, is by graphical means from Charts B through H. Each of these methods will be presented in order.

Analysis by Calculation. The first step in calculating the pressure loss in any particular component of the hy-

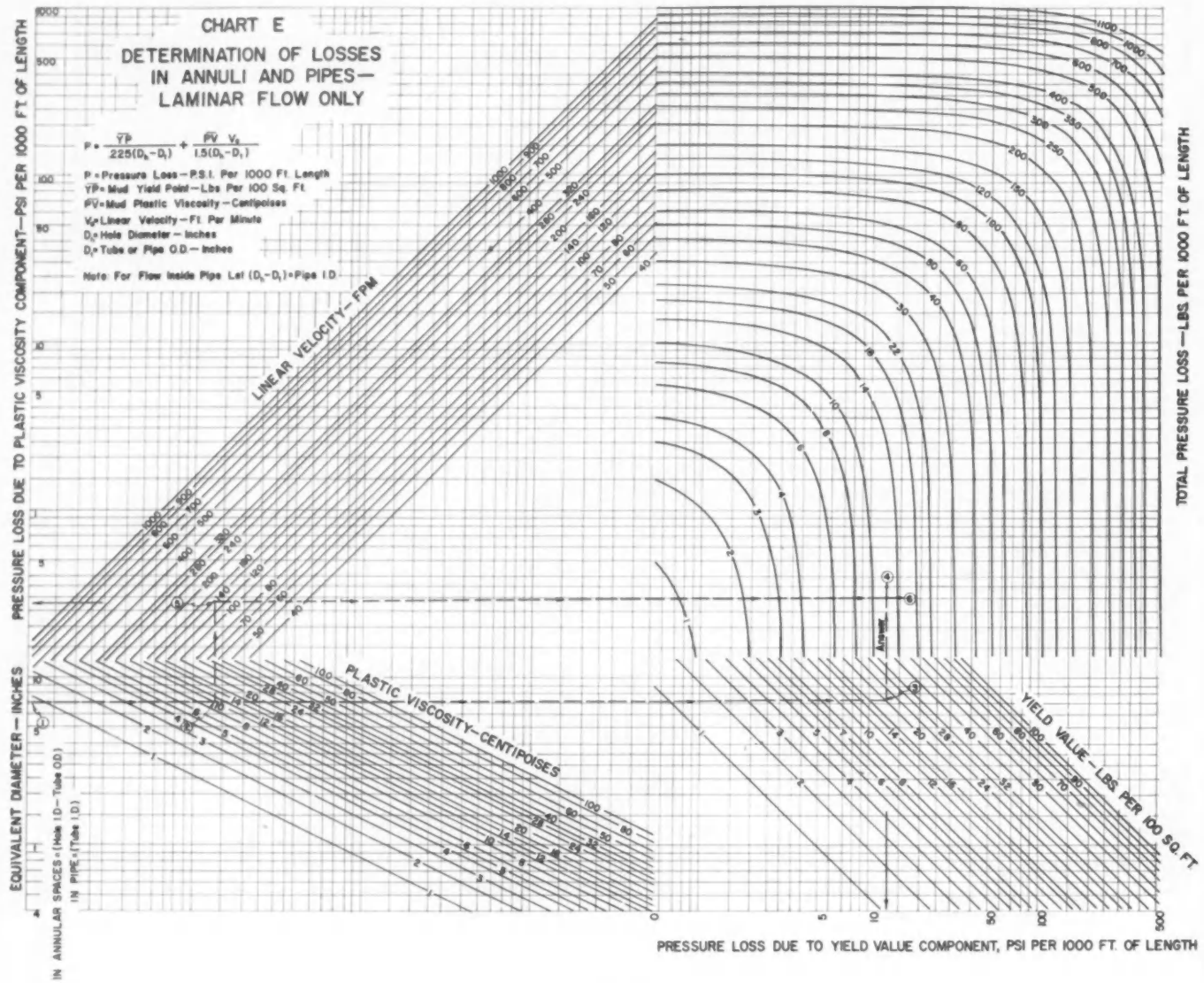


CHART E
DETERMINATION OF LOSSES IN ANNULI AND PIPES— LAMINAR FLOW ONLY
P = Pressure Loss — P.S.I. Per 1000 Ft. Length
YP = Mud Yield Point — Lbs Per 100 Sq. Ft.
PV = Mud Plastic Viscosity — Centipoises
Va = Linear Velocity — Ft. Per Minute
D2 = Hole Diameter — Inches
D1 = Tube or Pipe O.D. — Inches
Note: For Flow Inside Pipe Let (D2 − D1) = Pipe I.D.
LINEAR VELOCITY — FPM
PLASTIC VISCOSITY — CENTIPOISES
YIELD VALUE — LBS. PER 100 SQ. FT.
Answer
EQUIVALENT DIAMETER — INCHES
IN ANNULAR SPACES = (Hole I.D. − Tube O.D.)
IN PIPE = (Tube I.D.)
PRESSURE LOSS DUE TO PLASTIC VISCOSITY COMPONENT — PSI PER 1000 FT. OF LENGTH
TOTAL PRESSURE LOSS — LBS. PER 1000 FT. OF LENGTH
PRESSURE LOSS DUE TO YIELD VALUE COMPONENT, PSI PER 1000 FT. OF LENGTH

CHART E

draulic system (Figure 20) is the determination of the viscous properties of the drilling mud. The mud viscosity or its yield value and plastic viscosity can be obtained by testing with a Fann viscosimeter. Following this, the pump circulation rate should be established in order to determine the average velocities inside and outside the drill string. These velocities can be calculated using Equations 1 and 2 in Table 3. Next, Equation 3, 3A, 4, or 4A, Table 3, should be employed to find whether the flow in each specific section is turbulent or laminar. Finally, the pressure loss for that specific linear section can be calculated through the use of laminar or turbulent flow Equations 5, 5A, 6, 6A, 7 or 8. As an alternate to employment of Equation 3, 3A, 4 or 4A of Table 3 to ascertain the condition of flow, the pressure drops may be calculated by both turbulent and laminar flow equations. The equation which gives the higher pressure drop will represent the correct flow condition and be the proper value. The pressure drop or loss across the bit nozzles can be determined from Equation 9.

The pump discharge pressure is merely the summation of the pressure losses in each of the component sections of the hydraulic system. The total hydraulic horsepower output of the pump is directly proportional to the product of the pump discharge pressure and the mud circulation rate and can be calculated from Equation 10, Table 3.

Graphical Analysis. The pressure losses throughout the hydraulic system may be obtained by use of Charts B through H, which have been prepared to facilitate the determination. Velocities inside and outside the drill string may be ascertained from Chart B. The remaining charts may then be used to make the following determinations.

Chart

C Pressure loss in the surface connections. Turbulent flow.

D Pressure loss inside pipes or tubes. Turbulent flow. (Reynold's number range 60,000 to 1,000,000)

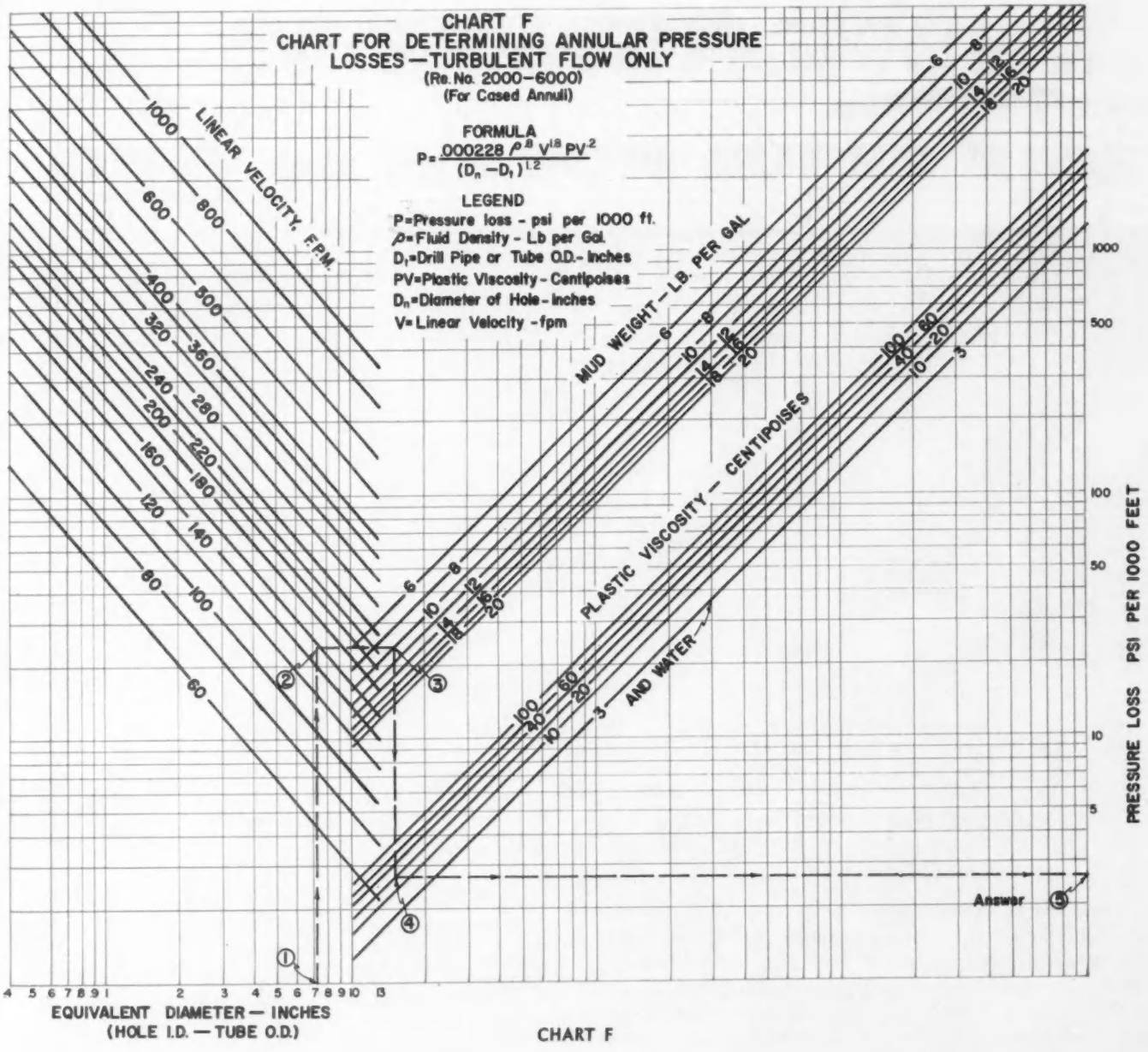


CHART F

E Pressure loss inside pipes or tubes, or for Annuli. Laminar flow.

F Pressure loss in Annuli. Turbulent flow. (Reynolds number range 2000 to 60,000)

G Pressure loss through bit nozzles for various weight muds and nozzle areas.

H Hydraulic horsepower from pressure and circulating rates.

Generally, the flow inside the drill pipe, collars, and surface equipment will be turbulent. On the other hand, laminar flow often prevails in the annular spaces. If the type of flow in a specific section is not known, the pressure loss should be determined for both laminar and turbulent conditions. The correct pressure loss, and the type of flow, will always correspond to the higher value. For non-Newtonian fluids, this represents the most accurate method of determining the condition of flow.

"Useful" and "Parasitic" Energy. The jet bit horsepower, which is expended in "sweeping" of the bottom hole surface can be determined by replacing P_d in Equation 10 with the pressure (P) as derived from Equation 9.

$$\text{(Horsepower at Bit)}\quad HP_B = \frac{\overline{GPM^3} \cdot \rho}{20.6\,(10)^6\,A^2C^2} \qquad (11)$$

The horsepower expenditures below the bit represents useful energy because it contributes to the bit's performance. However, the pressure and horsepower loss which occurs inside and outside the drill string represents wasted or parasitic energy. The major portion of this energy loss is inside the drill pipe and collars. This represents one of the undesirable features of rotary drilling from the standpoint of rig economics and bit performance. These losses can not be eliminated but they can be minimized. The formulae developed for determining the pressure losses within the drill string for Chart D may be used to illustrate this:

$$\text{(pressure loss in pipe)}\quad P = \frac{.08L\rho^{.84}\,\overline{G.P.M.}^{1.84}\,\overline{P.V.}^{.36}}{D^{4.84}} \qquad (12)$$

PRESSURE DROP ACROSS BIT NOZZLES FOR VARIOUS WEIGHT MUDS AND NOZZLE AREAS

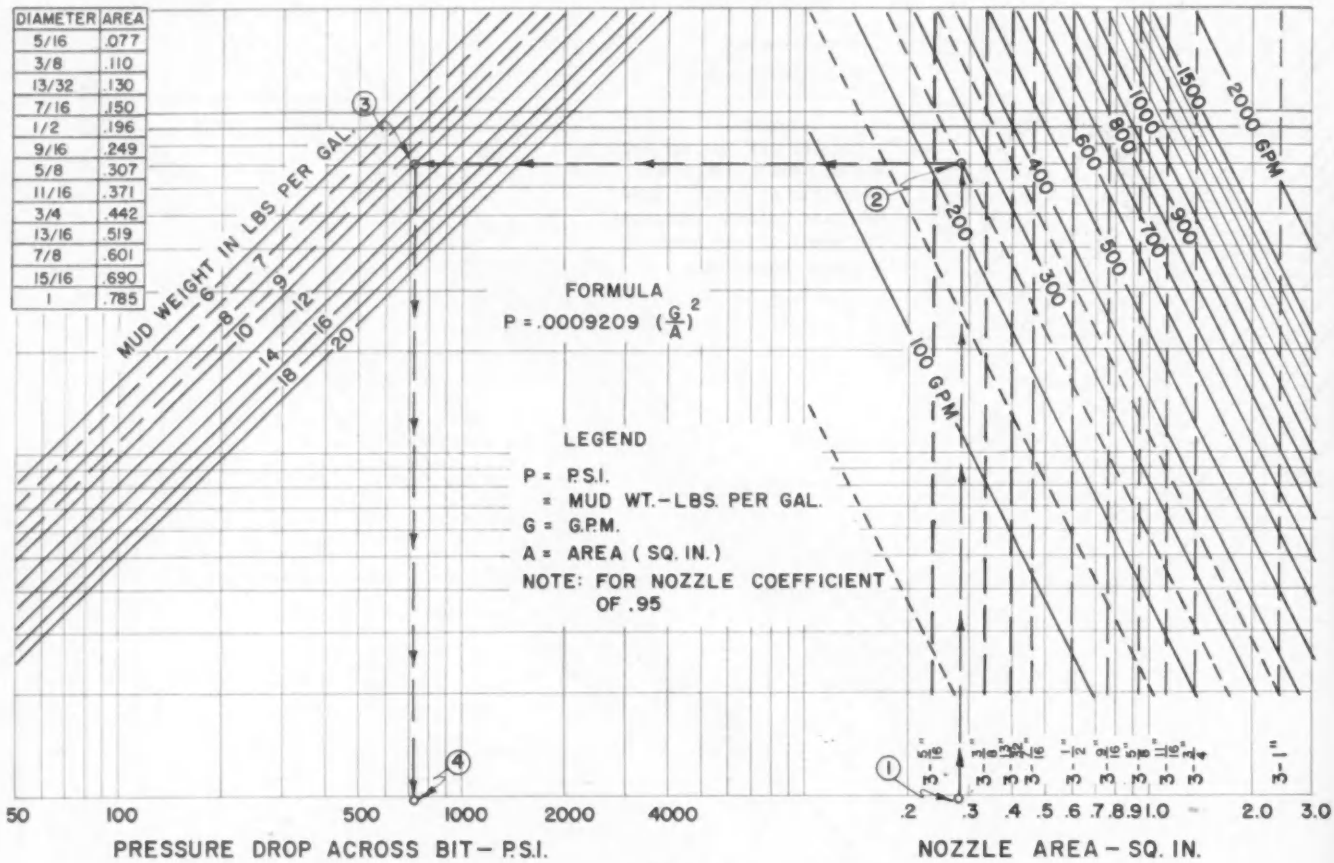


CHART G

Equation 12 shows that the losses inside the drill string may be lessened either by reducing the circulation rate or by increasing the size of the drill pipe and collars (the inside diameter). Equation 12 shows also that a 10 percent reduction in pumping rate will result in an 18 percent reduction in pressure loss. Also, a 10 percent increase in pipe diameter will reflect a 37 percent reduction in pressure loss, which, as has been described, is parasitic.

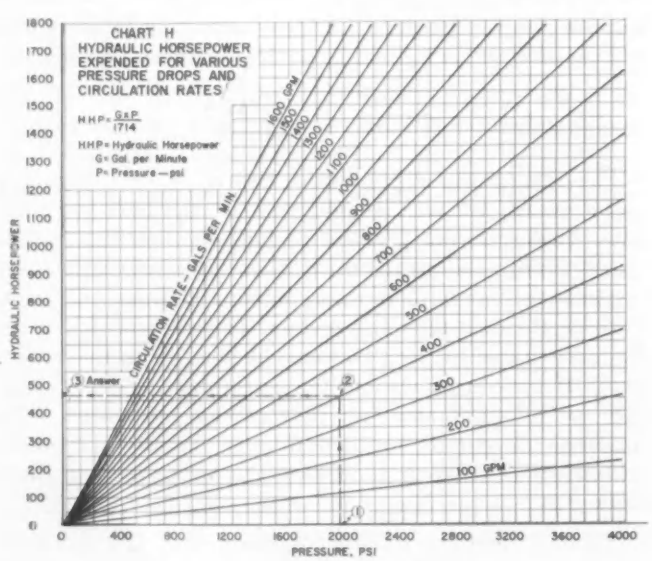


CHART H

TABLE 4
Nomenclature

GPM = Gal. per min. flow rate
Vi = Avg. velocity in pipe, fps
Va = Avg. velocity in annulus, fps
Vn = Nozzle velocity, fps
Vlc = Lower critical velocity, fps (flow velocities less than this indicate Laminar flow conditions)
Di = Diameter inside pipe or tube-inches
D_h = Hole diameter—inches
D_t = Outside diameter of pipe or tube-inches
ρ = Fluid density, lbs. per gal.
μ = Viscosity (Newtonian Fluids)—centipoises
$\overline{PV}$ = Plastic viscosity (Non-Newtonian Fluids)—centipoises
$\overline{YP}$ = Yield point (Non-Newtonian Fluids)—pounds per 100 ft.[2]
p = Pressure loss in any given linear section, psi
P_d = Pump discharge pressure, psi
L = Annular length of pipe or tube feet
A = Total cross sectional area of bit nozzle openings—square inches
f = Turbulent flow friction factor (Determined from Chart A for either Newtonian or Non-Newtonian Bingham Plastic Fluids).
C = Bit nozzle coefficient (.95 for current jet bits)
HHP = Hydraulic horsepower
Q = Designation for flow rate in cubic feet per second

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(c) Hedstrom, B. O. A., "Flow of Plastic Materials in Pipes," Ind. Eng. Chem., 1952.
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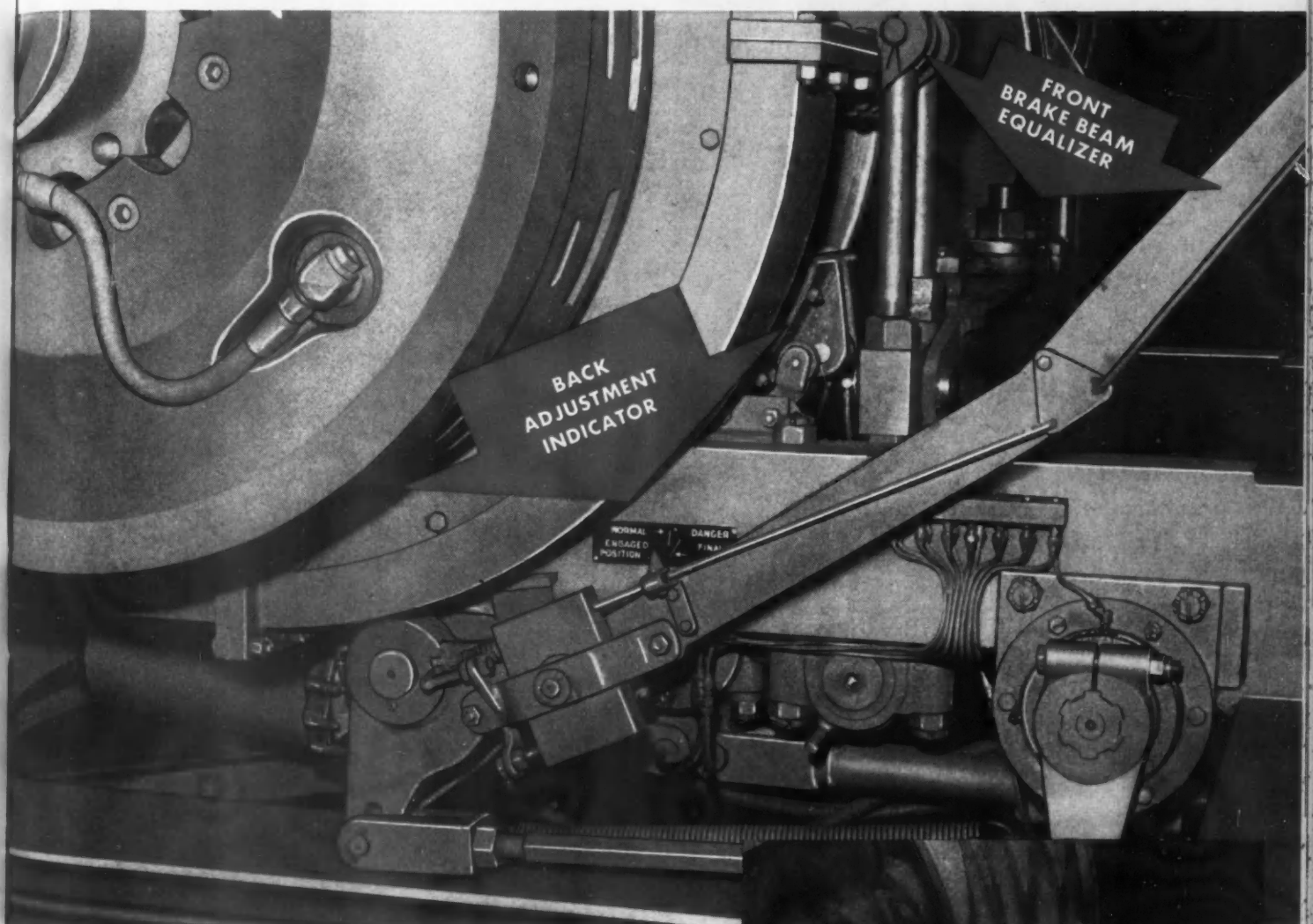

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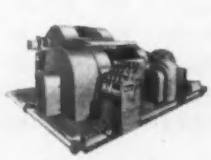
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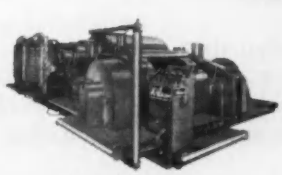
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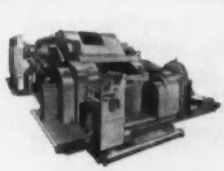
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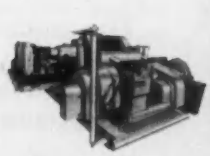
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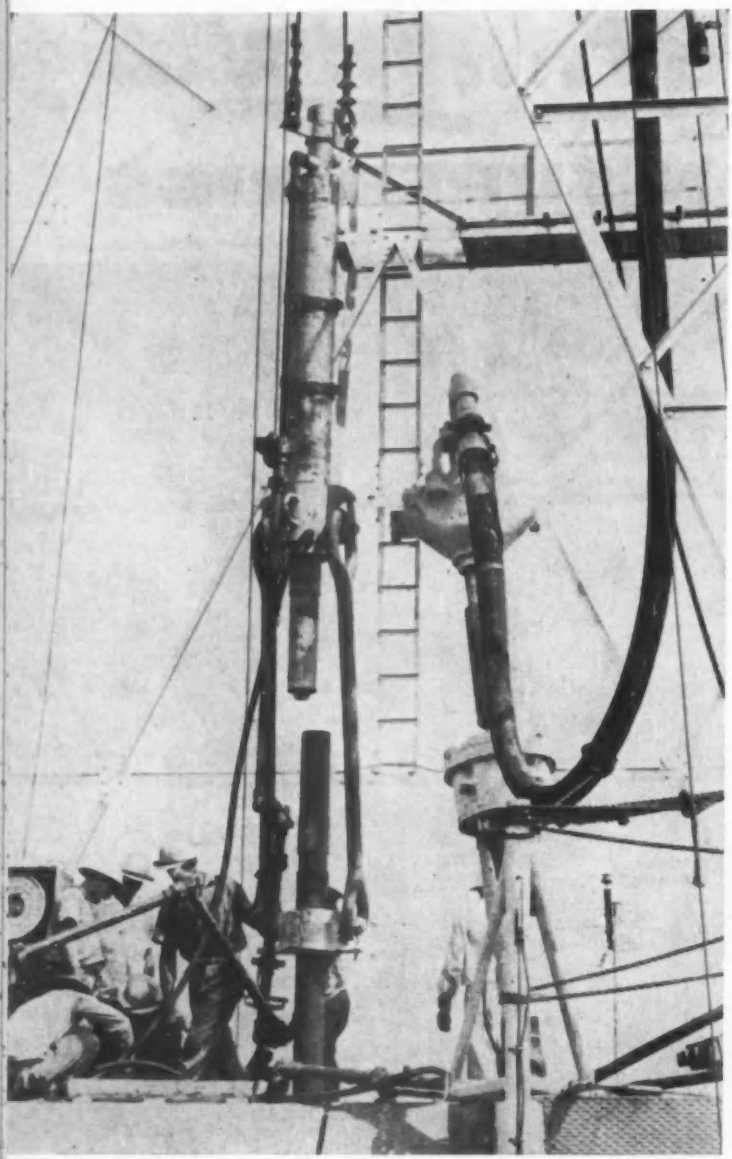

FIGURE 1—With packer retracted into its protective sheath, tool is being swung out over the hole. For purpose of timing, this point of operation is considered time zero. The well can blow around the packer and also through the packer and out the bypass at the top.

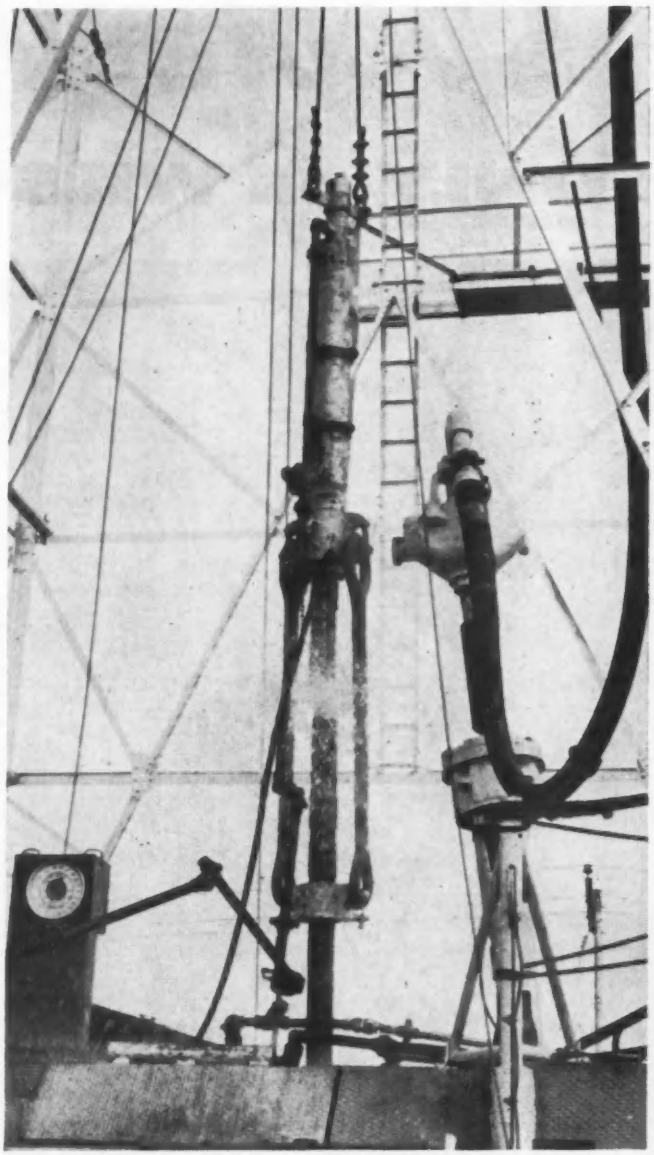

FIGURE 2—Time: 3 seconds. With blowout started, tool is just starting to enter the hole. Packer is not yet inserted. For purpose of test, heavy flow of water with high volume of compressed air, were used to create "blowout" for testing of tool and training of crews.

New Equipment Designed for Creole's Blowout Control

Newly designed equipment, standardized procedure and trained personnel are Creole's insurance against wild wells.

By J. E. ORTLOFF
The Carter Oil Company, Tulsa
E. H. CLARK
Baker Oil Tools, Inc., Los Angeles

THE DREADED WORD "blowout" may never be any less feared but, for Creole Petroleum Corporation and their operations in the Lake Maracaibo area of Venezuela, the problems and costs involved in killing a wild well may be greatly reduced through the efforts of that company's blowout control committee and some very recently developed specialized control equipment. A unique and very effective control packer device, only recently built and tested under simulated blowout conditions, seems destined to play an important role in not only the Lake Maracaibo blowout control program, but in land operations elsewhere as well.

The new control equipment, called a "stinger blowout control device," is a cylindrical tool approximately 10 feet long by 12 inches outside diameter. Designed to pack off from the inside, the tool offers the advantage of providing a means of latching to the casing stub or well head equipment while the unit is held to one side and out of the flow stream.

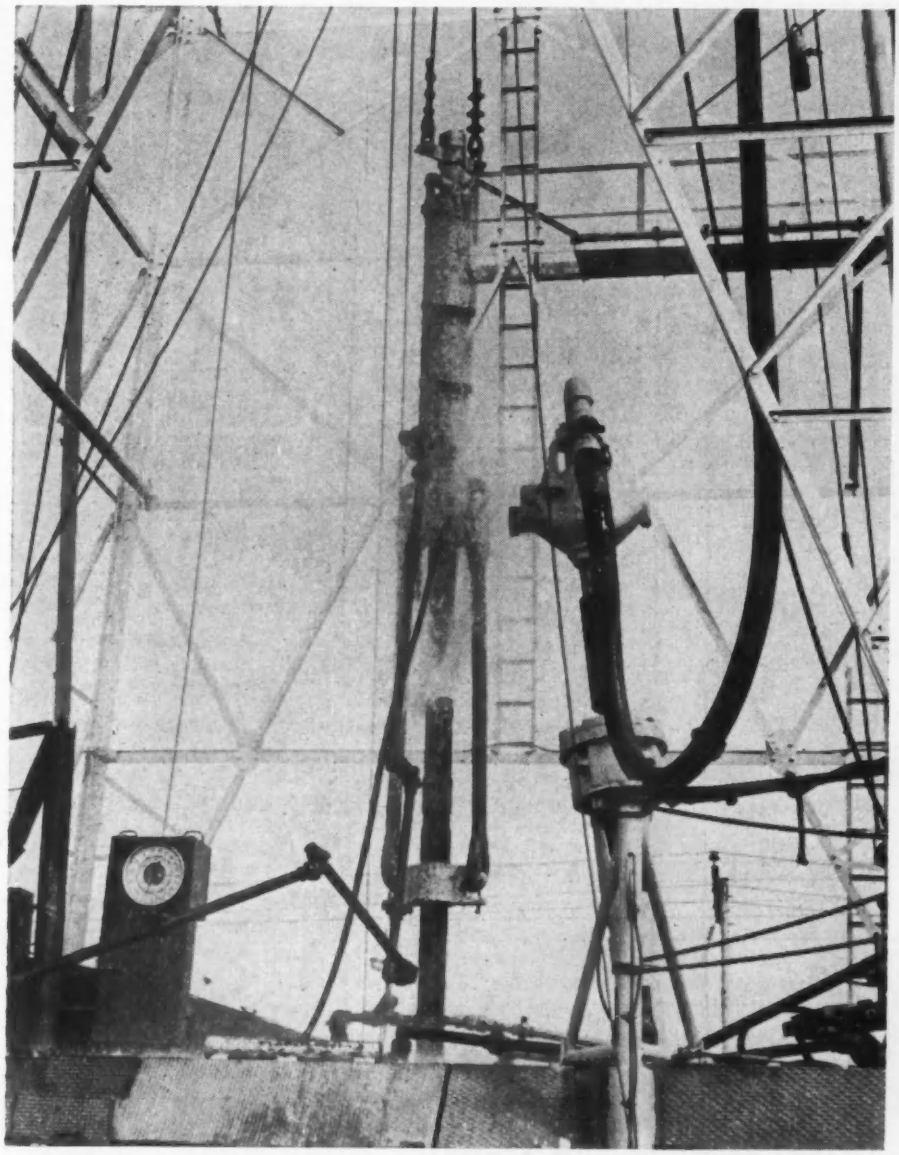

FIGURE 3—Time: 19 seconds. Packer has been inserted approximately six feet, the tail pipe has been pulled down and the retaining pin sheared. The flapper valve in the top of the tool has closed, shutting off the flow through the upper end of the unit.

When ready, it is swung out over the stream and, while the main force is by-passed through the tool bore, mud pressure entering through a side port, rams a piston-actuated packer down into the casing.

In rapid succession, and automatically, as mud pressure is applied, the sheath covered packer enters the well, the flow is shut off, and, with continued pumping, the well finally is killed. Design of the unit is such that there are no slips on the packer, but the greater the pressure exerted against it in the well, the tighter the packer is locked in the pipe.

If, for any reason the packer has to be removed, this also can be done against the full force of the blowout merely by applying pump pressure against the bottom of the double-acting hydraulic cylinder. In actual tests during a simulated blowout, the entire operation, once the equipment was rigged, required only 20 to 25 seconds to insert the packer, automatically set it, and begin the pump-in killing operation.

The ultimate aim of Creole Petroleum is to establish a blowout control organization that might be likened to a fire department which, when a blowout occurs, will be instantly available. Equipped with highly specialized equipment, of which the above stinger blowout control device is one of the major pieces, and including divers and diving equipment and all types of tools and safety gear, this task force would take over control of operations in the early stages of a blowout with far less confusion and expense than usually occurs. It is Creole's hope that other operators in the area will ultimately join in the formation of this emergency unit so its service will be available wherever and whenever it is needed.

Creole, like operating companies in many other parts of the world, is faced with the continual problem of potential blowouts. Despite today's use of the best available equipment, installations of many years ago often do not match the quality and operating flexibility of current equipment. Also, some of the wellhead equipment may be weakened by corrosion and the effect of time.

Despite the taking of all possible precautions, very little margin of error is allowable in many instances. During workover operations, for example, reservoir pressures sometimes are barely held in check by a static column of heavy crude oil and work must proceed very cautiously. Crude oil is used in some cases, to avoid loss of heavier and damaging fluids into the reservoir. There are other hazards such as the possibility of breaking a surface fitting, or damage caused by the accidental bumping by a ship or barge. Then, too, because of the rapid expansion of drilling and producing activity in the area, and in spite of intensive training programs, it is becoming increasingly difficult to always have a fully trained crew, with highly trained supervision, at each and every rig.

When wells get out of control, they very often blow as much as 6000 to 8000 barrels per day, along with millions of cubic feet of gas. This creates an extremely costly and hazardous situation, particularly since the oil may float on top of the lake for some time and constitute an acute fire hazard over a large area. The urgency of developing a ready force, with specialized equipment and highly trained personnel, therefore was apparent and plans were set in motion for a joint effort aimed at solving the problem.

A blowout control committee, under the direction of George B. Wepsala, Jr., chief drilling engineer of Creole Petroleum, was organized to investigate not only preventative practices, but to set up a pre-planned group of blowout control devices sufficiently universal as to be usable immediately on any blowout which

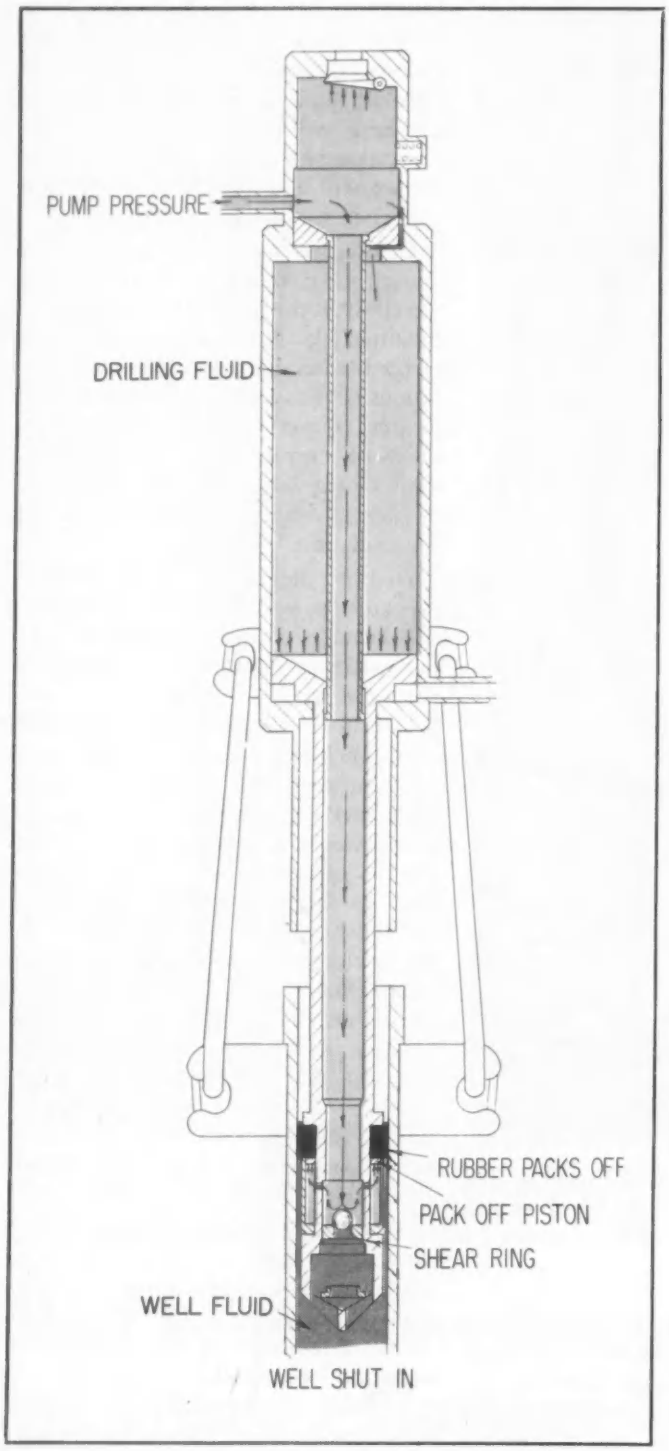

FIGURE 4—Time: 20 seconds. The packer has been set and the well flow has been shut in.

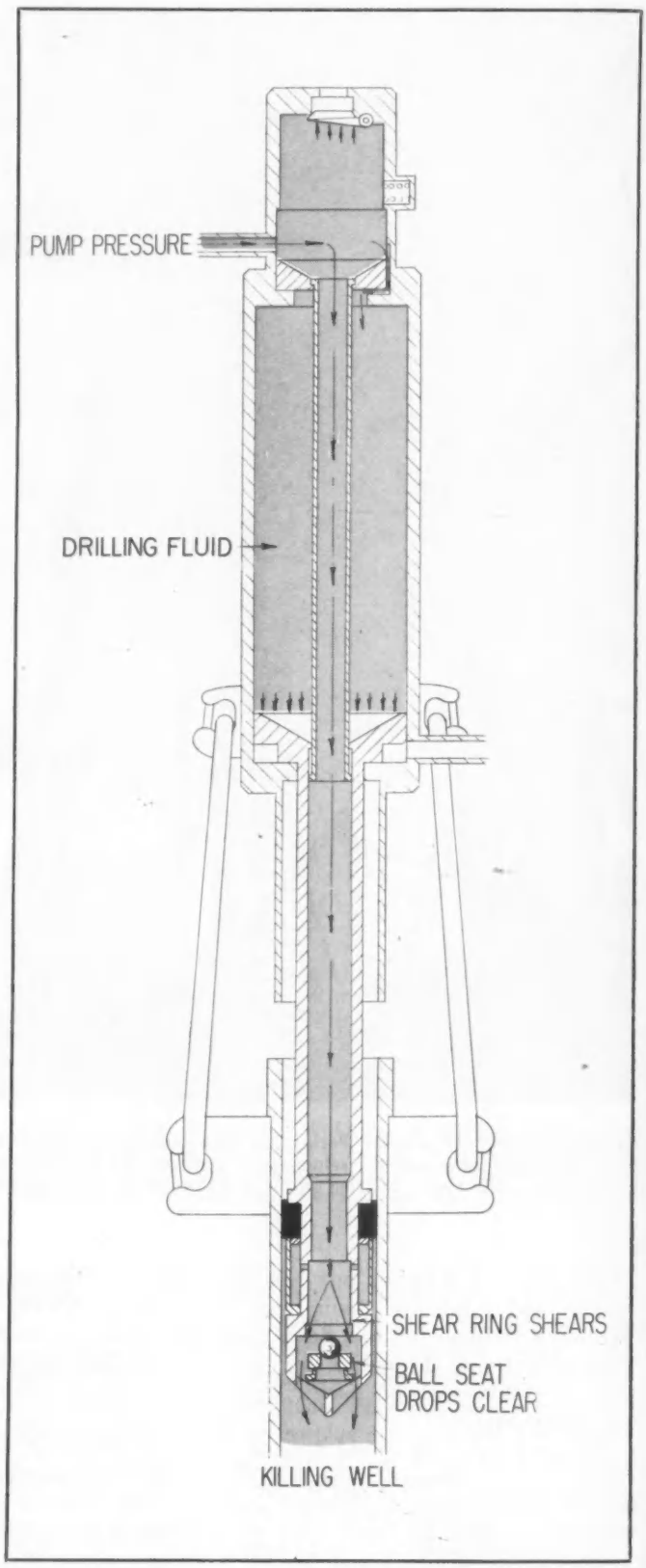

FIGURE 5—In actual blowout operations, mud or fluid continues to be pumped into the hole until the well is killed. If for any reason, such as rupture of casing or other emergency, a releasing procedure is provided for retrieving tool under full pressure.

might occur in their Maracaibo operations.

To handle the details of this job and work with suppliers who eventually would furnish the equipment, Creole worked through their parent organization, Standard Oil Company (New Jersey) and turned the project over to The Carter Oil Company Research Laboratory engineers. The latter not only conceived the general scheme in consultation with the Creole operating engineers, but also acted as general contractor with various equipment manufacturers who worked out the detailed design, manufactured, and tested the finished equipment.

Many devices were discussed and, eventually, contracts were issued for a latching overshot device and for a plunger-packer device. In addition, design work was authorized for other developments which could be used either above water or below the sur-

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face of the water. Further work also was done on preparatory equipment that would be required in using these devices, such as strippers for cutting away conductor pipe where necessary, cutting off tubing or casing where necessary, or dropping tubing down the hole if required.

The first of these specially-designed devices to be completed, tested and shipped to Venezuela for field work and crew instruction, was the control unit described briefly earlier in this article.

Development of this new device was fraught with a great many practical problems. To begin with, it soon was realized that the fewer the number of pump lines which had to be run to the equipment, the better the entire operation would be, since, at the moment of closure, activities are at best highly confusing. Switching pumping equipment from one line to another, or coordinating the activities of multiple pumps, was considered out of the question.

It was obvious, therefore, that maximum efficiency would be obtained if only one pump-in line were required. Pressure through the pump-in line not only should provide power for inserting the packer, but also, at the proper time should automatically set it, then open a port through it so continued pumping would force killing fluid down the well bore. It was felt also that it would be highly desirable to have a by-pass of as large diameter as possible through the central portion of the tool, which would remain open until the latest possible instant to retard cutting of the casing or the packer as the latter was being inserted into the well bore. It further seemed mandatory that the external portion of the packer should be completely encased in the steel sleeve during the insertion process to prevent premature seal expansion or abrasion damage. Once inserted and set, the packer would be held in place, not by slips, but by the well pressure acting on the hydraulic ram.

Added to these requirements was the job of designing the operation so it would be as nearly automatic and fool-proof as humanly possible. At the same time building into it sufficient strength to enable it to withstand 5000 pounds per square inch design pressure and making the tool adaptable to a simple change-over for any casing size from 5½ inch through 9⅝ inch size. To insure absolutely safe operation under the 5000 pound per square inch design limit, manufacturers' engineers raised this to 7500 pounds per square inch test pressure and started to work out the operational details.

The first workable design was created in approximately four days and readied for conference. Subsequent consultations and conferences brought about refinements and weight reductions. When all of the design problems had been checked by all concerned, manufacturing was initiated and the finished packer completed in a short 30 days.

The final result can be seen in the accompanying schematic diagrams showing, in successive steps, the insertion, the packer setting operations and the emergency releasing sequence.

Step 1, or insertion of the packer, begins after the unit has been securely latched to the wellhead and raised to the center of the blowout stream over the open casing. Initial pump pressure is applied only to the top of the hydraulic piston, forcing the packer into the well bore against the blowout pressure. A centering guide with a pointed nose, below the packer, takes care of any misalignment which might occur during this phase. The outer surface of the packer is completely encased in a heat-treated steel sleeve to prevent cutting damage. At this time, the well is blowing not only around the outside of the packer but also through the center of the tool and out the by-pass at the top.

When the packer has been inserted approximately six feet inside of the casing, the shoulder on the inside of the piston picks up the telescoping tail pipe and pulls it down with the packer. This is Step 2 after it has sheared the rtaining pin which positions it. As this tail pipe pulls through the flapper valve ports, the flapper valve swings shut, closing off the flow through the upper end of the unit. At roughly 6½ feet of stroke, the end of the tail pipe passes the ball injection unit and the spring-loaded ball is injected into the open end of the tail pipe.

The shoulder on the tail pipe next contacts its seat in the port cover and automatically pulls the port cover down until the piston bottoms out, this is the third step. At this point, pressure from the blowout communicates into the pump-in line and on the top of the hydraulic insertion piston. The cross-sectional area of this insertion piston is such that it is always greater than the area underneath the packer and, since both are exposed to the same pressure, the piston is held at the bottom of its stroke, regardless of how much pressure builds up.

As additional fluid is pumped in, the fluid, aided by gravity, carries the heavy ball down to its seat in the packer, as shown in Figure 4. When the ball hits its seat, it moves the sliding ball seat downward, uncovering the ports to the setting mechanism of the packer, and the ball seat finally comes to rest on a shear ring in the bottom of the packer. This shear ring is protected during the insertion phase by a fluid deflector which is expendable in relation to the cutting action of the blowout fluid.

Pressure is then built up in the packer setting mechanism against this shear ring. The first action on the packer is the removal of the steel cover (Step 4) from the packing element. When the cover has been removed, the fluid acts on the pack-off piston which, being forced upward, expands the packing element (Figure 4), thereby shutting in the well.

Additional pressure then can be built up to break the final shear ring (Step 6) and open a direct pump-in passage to the casing for killing the well. (Figure 5)

Should any portion of the packer fail to operate satisfactory, or if the well casing should fail under the shut-in pressure, an emergency releasing procedure (Step 7), for retrieving the tool under full pressure, is also provided. To accomplish this, it is necessary only to change the pump-in equipment to pump into the retraction line at the bottom of the double-acting hydraulic cylinder. Pressure under the piston then will hydraulically pull the packer from the well, even under full blowout pressure, and the unit can be swung to the side and disconnected from the wellhead.

The finished tool was subjected to operational tests at the plant at a test pressure of 7500 pounds per square inch, to insure its safety under actual conditions in the field. After several minor modifications aimed chiefly at simplification of construction and assembly of the tool, and final inspection and tests, the packer unit was

Continued on Page 112

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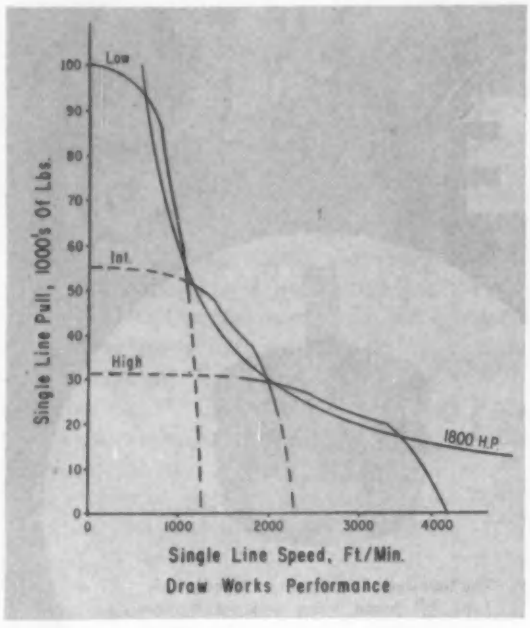


FIGURE 9—This graph shows the output performance of two shunt motors, each powered by two differential generators with an engine input to each generator of 600 hp maximum. Three speed ratios provide 1800 hp over the entire operating range of the drawworks.

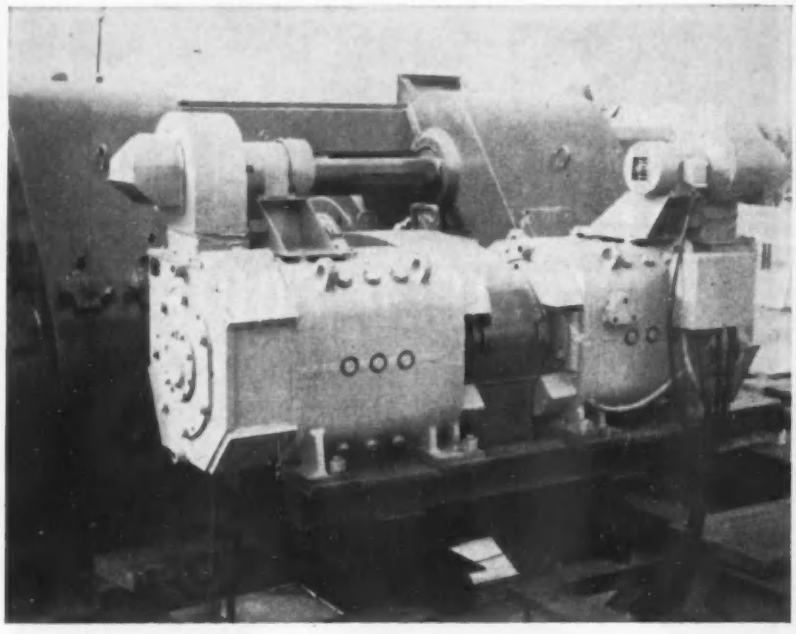


FIGURE 10—Two continuous rated 600 hp shunt motors mounted behind drawworks. On small drawworks, or where properly mounted on large drawworks, it is not necessary to break the drive chain when moving the rig. Thus there are no alignment problems between the motors and the drawworks; no engine or compound alignments to be made.

Fundamentals of . . .

Electric Power Transmission for Drilling Rigs

Part 3: Electric Drive Application to Rotary Rig Operation

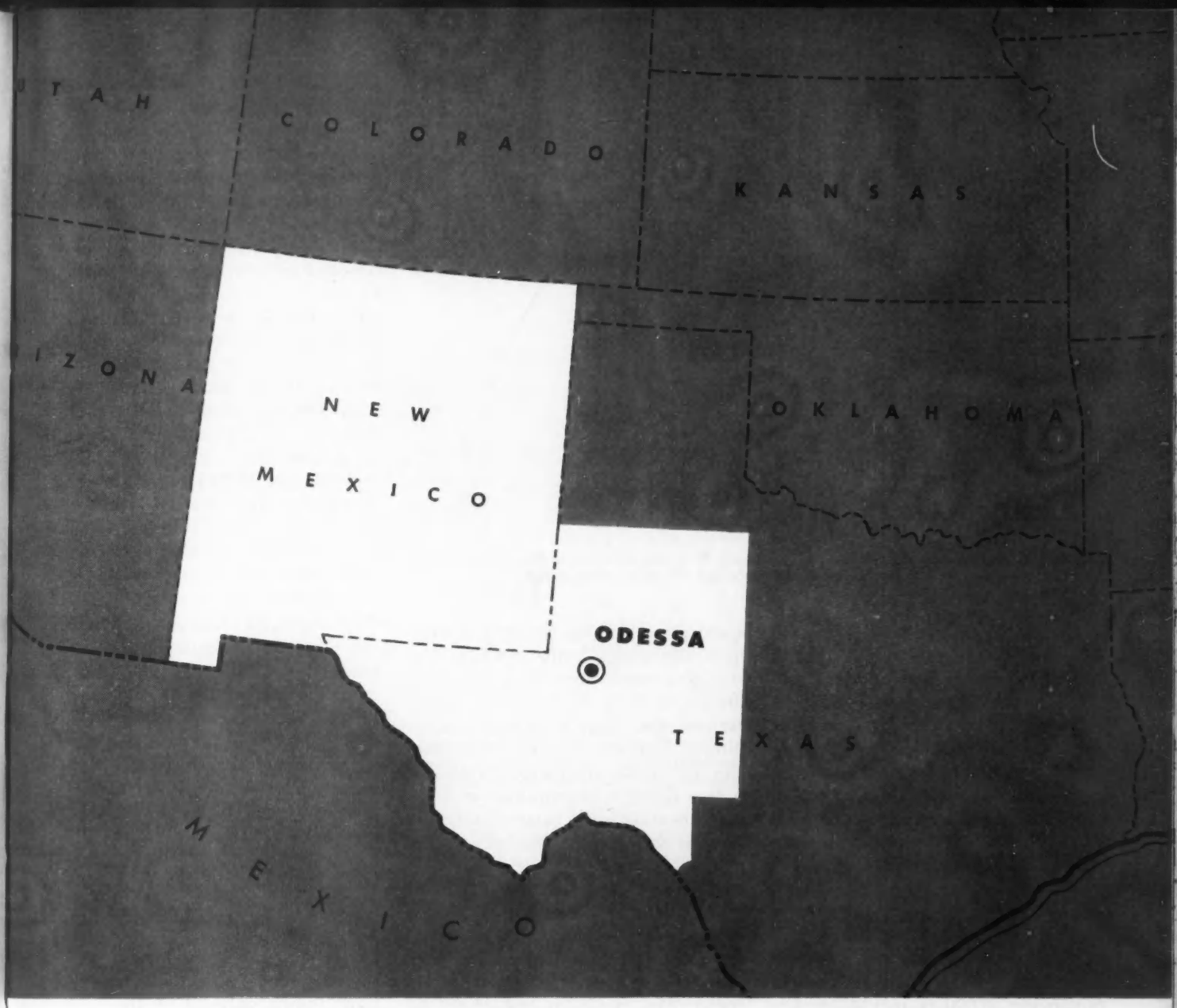
The operating characteristics of drawworks, pumps, and rotary along with the inherent speed and torque control are explained together with some of the more obvious advantages of diesel-electric drive.

By GLENN W. WEBB, Application Engineer
General Electric Company, Dallas

THE FUNDAMENTALS of diesel electric generation, transmission and drive were explained in Part 1 of this article, and in the second part the characteristics of series and shunt wound generators and motors were explained. In this third, and concluding part, a brief explanation is given of the applicability of electric drive to the various parts of the rotary rig: the drawworks, mud pumps and rotary table.

Drawworks Application. Figure 1 (Part 1) represents the ideal speed-torque curve for a large drawworks and the curve of Figure 5B (Part 2) represents the shape of the speed-torque curve produced by the shunt motor and three-field differential generator. Figure 1 indicates that maximum power is required from about 1000 fpm line speed upward. Assuming a 10-foot drum circumference, this would mean full power at 100 rpm of the drum. In order to reduce size and cost a practical drilling motor would develop maximum power at about 900 to 1000 rpm. This means that two chain reductions are required to reduce motor speed to drum speed. Since a jackshaft is required for this purpose and for cathead drive, etc., four chain ratios become available.

The lowest ratio should be selected to provide the maximum line pull for emergency conditions, and the high-



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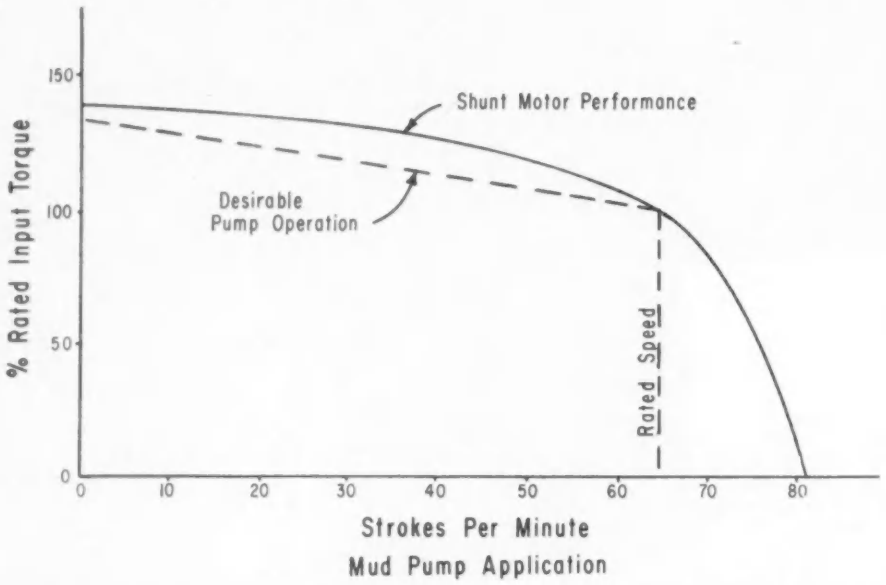

FIGURE 11—Shunt motor application to a mud pump. By proper selection of the chain ratio the maximum motor horsepower is provided at rated pump speed.

est speed ratio to provide the desired maximum empty hook speed. The intermediate ratio would be selected to cover the operating range between low and high. Figure 9 shows the output performance of two shunt motors, each powered by two differential generators with an engine input to each generator of 600 hp maximum. Low gear has been arbitrarily selected to provide an emergency single line pull of 100,000 pounds. High gear has been similarly selected to provide a maximum single line speed of 4000 fpm. The intermediate chain ratio was selected to provide 50,000 pounds single line pull at full power, and as can be seen, a fourth ratio is not required. In fact, on many drawworks, two mechanical speed ratios would suffice. The two motors provide a maximum output of 2000 hp which would be reduced proportionately if the engines were set for a lower output and still would not tend to overload the engines. As can be seen, the available power exceeds 1800 hp over the entire operating range of the drawworks. The high speed ratio could be used up to about 30,000 pounds, the intermediate ratio from there to 50,000 pounds and low only for very heavy loads or emergencies.

The curves plotted are for full throttle. At reduced throttle positions a family of curves is obtained with lower limits on torque and speed as shown in Figure 7A, (Part 2). Under all conditions the drive system inherently limits torque at stall, and speed at no load. In between, it automatically trades torque for speed as the load accelerates. With the drive motors stalled, applying maximum torque, the engines would be running at high idle lightly loaded, since the only power demanded would be a few horsepower required to overcome heating losses in circulating stall current through the motors.

Mud Pump Application. Figure 11 illustrates the shunt motor application to a mud pump. The chain ratio is selected to provide maximum motor horsepower at rated pump speed. The maximum stalled torque of the motor is adjusted (by adjusting the strength of the motor field) so that it is some 30 to 50 percent higher than the torque required at rated pump speed. Although pump manufacturers do not publish figures on the maximum permissible applied torque under stalled conditions, it is generally agreed that some such increase at stall is acceptable. Actually, the shunt motor can be adjusted to provide what ever increase is desired from about 30 percent upward. Once the maximum input torque at stall is set, the drive system cannot exceed it under operating conditions.

The maximum speed of the motor under no load conditions is also affected when the field strength is adjusted for stalled torque. Raising torque reduces speed and vice-versa as mentioned previously. The limitation on no load speed would generally be dictated by the permissible chain speed. The shunt motor speed is easily held within chain speed limitations.

Rotary Table Application. For separately driven rotary tables, the drive performance is best illustrated by showing an actual family of curves obtained at different throttle settings, Figure 12. This is a representative application of a direct drive to a rotary with an assumed gear ratio of 3.5 to 1. At maximum throttle (Curve 10), the shunt motor field has been adjusted to give a top rotary speed of 395 rpm which provides a maximum rotary torque under stalled conditions of 12,800 pounds per foot. This torque represents 80 percent of the torsional yield strength for 3½ inch drill pipe and cannot be exceeded with this drive, providing sure protection against twist-off.

A dot-dashed curve representing full motor field setting is shown for comparison to illustrate the effect of strengthening the motor field. As can be seen this increases torque at stall and reduces maximum speed at no load as would be deduced from Equations 3 and 4a, (Part 2). Even this torque is well below the allowable torque for 4½-inch drill pipe.

To examine the performance of the shunt motor powered by one differential generator, let us assume that 2000 pounds per foot of torque are required to rotate the pipe string. In order to simplify the explanation, we have shown only 10 of the infinite number of throttle setting curves available. In starting up, we move the throttle from OFF to the first step (Curve 1). This takes up slack and applies about 1300 pounds per foot of torque, not enough to start rotation. The second step, however, applies more than 2000 pounds per foot so the table starts rotating and accelerates to 40 rpm along the dotted line, where it runs until we advance the throttle to step 3.

On throttle position 3, additional torque is applied to accelerate the table to 90 rpm. This process can be stopped at any desired speed or continued until at full throttle the table would be running at 380 rpm on Curve 10. Assume we now decrease the throttle setting to step 8. The rotary drops back in speed to 300 rpm if 2000 pounds per foot of torque are still required. Leaving the throttle set at this point, assume that

hole conditions change tending to exert twice as much friction on the pipe. Now 4000 pounds per foot of torque would be required, and the drive would slow down along Curve 8 to about 280 rpm in order to develop this additional torque. If load were removed it would speed up to 310 rpm which is its top speed at this throttle setting.

It is evident from the above that for any load (torque) condition, the drive can be adjusted to run continuously at any desired speed from zero to the top speed for which it is geared. For any throttle setting the motor automatically adjusts its speed along the corresponding curve to compensate for changes in torque requirements. The same type of performance applies, of course, to the drawworks and pump drives except that two generators may be connected in parallel to each motor, thereby increasing the available current and torque.

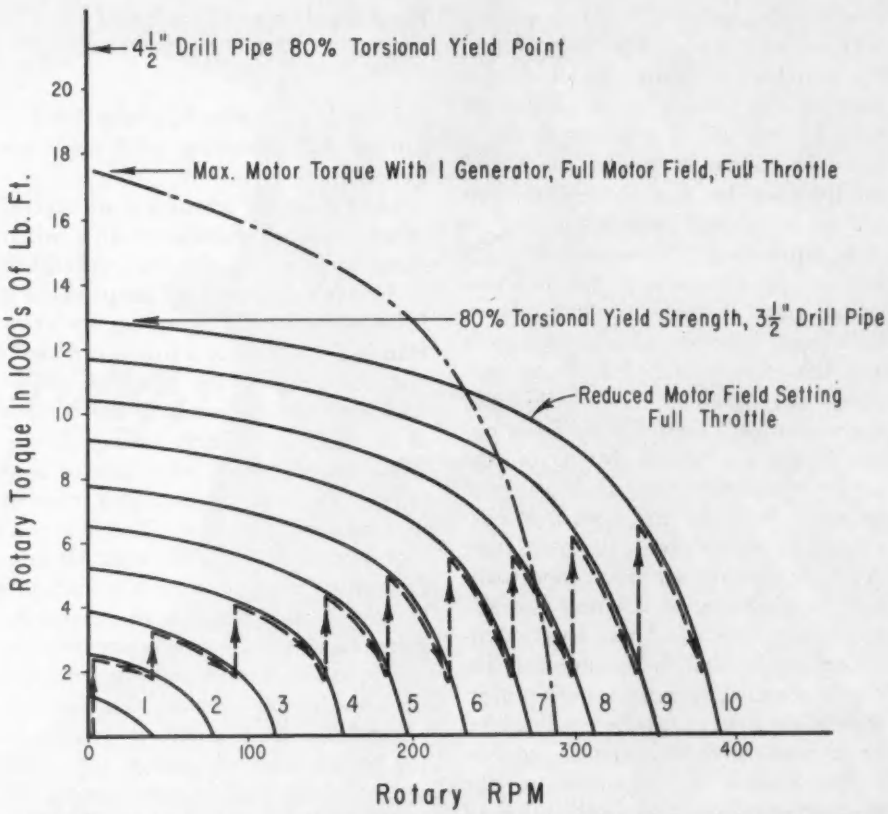

FIGURE 12—A family of curves obtained at different throttle settings for an independent rotary table drive. The shunt motor field can be adjusted to provide a maximum rotary torque under stalled conditions representing 80 percent of the torsional yield of the drill pipe to be used. This torque cannot be exceeded with this drive thus providing sure protection against twist-off.

Advantages of Electric Transmission. The advantages of electric power transmission of course vary with the size and layout of the particular rig. Among them are the following:

1. Flexibility of arrangement. With the driven machines connected to the power source through flexible cables, great freedom of location and arrangement of equipment is afforded. The motors are relatively small, being about 30 inches in diameter and 50 inches long, and are generally unitized on the same skid or base with the driven machines. Thus there are no lineup problems in setting up on location. The engine-generator sets can be located remotely in the engine room on a barge, on a separate power trailer for a portable land rig or on skids away from the drilling platform.

2. Weight reduction. Removing the engines and compound from the drilling platform offers obvious savings in substructure size and weight. This is particularly important on offshore platform-tender operations where platform space is expensive. The drawworks weight itself can be reduced by elimination of some speed ratios and the use of jaw clutches.

3. Quick moving. Compact unitized components, cable connected instead of mechanically lined-up and connected offers important reduction in set-up and tear-down times. It also eliminates many man hours of hard labor. One user estimates 40 percent reduction in moving time for a medium depth portable land rig.

4. Reduced maintenance. It has been shown how the electric transmission described above protects the engines against shock loads and overloads. It also applies power smoothly to the drilling machinery, slowing down to pull harder as loads increase and inherently limiting maximum torques and maximum speeds. These characteristics mean less maintenance and longer life for engines and machinery. Torque converters, variable speed couplings, and two-speed pump drives are eliminated.

The electric equipment itself has proven to be low in maintenance expense compared to mechanical and hydraulic transmissions. Greasing is practically eliminated since bearings are sealed and regreased at three year overhaul intervals. The simple control circuitry of this system eliminates all complicated regulating equipment, utilizes familiar air controls, and can easily be understood and serviced by the average electrician.

5. Flexibility of Power Assignment. Standard systems are so arranged that alternate sources of power are available to any load with any engine-generator set out of service. Almost any degree of flexibility of engine power assignment can be provided up to the point of assigning any generator to any load singly or in multiples. If sufficient engine power is available, the mud mix pump can be driven off the rotary table generator, leaving all other generators available for pumping down the hole. Instead of extra engines being required for split rigs, all power can be utilized for drilling or for hoisting.

6. Safety. Exposure to fire hazard is reduced by locating power units and pumps away from the hole. The drilling platform is free from engine noise and vibration and uncluttered for safer working conditions. Protection is provided against loss of ventilation, engine failure, overloading, and electrical faults. An emergency stop shuts down all power.

7. Adaptability to Changes. The basic components, being cable connected, can be put together in many combinations. This means motors or generators can be added or subtracted in the future, or the engines

can be changed. Additional control features can be incorporated should the customer so desire. In some cases part of the power units or pumps may be left off if not required on some locations, or power units and pumps may be traded between rigs for more efficient utilization.

8. Operating Characteristics. Inherent limitations on torque and speed have been discussed above. Efficiency between the engine shaft and the motor shaft of 85 to 88 percent, are obtained. This efficiency stays relatively constant over the entire operating speed range of the motors, which means that reduced pump speeds do not sacrifice efficiency. Sustained creeping speeds are available for pulling stuck pipe without the necessity of slipping clutches or endangering the drive. Instrumentation is provided to continuously indicate torques, speeds or horsepower. Recording meters can be easily added to analyze the drilling power requirements toward improvement of the drilling program. Synchronization of engines is not critical.

9. Initial Cost. The items enumerated above represent dollar savings in the cost of mechanical equipment and its operation and maintenance. Electrical equipment offered in the past was high in first cost and this idea persists. Actually the drilling motors and generators described above cost much less per horsepower than the general purpose industrial type machines previously available. Electric drives are still generally applied to equipment designed for mechanical drive and hence cannot realize all the potential savings. Even so, on larger rigs the first cost of electric transmission is often lower than mechanical transmissions offering comparable power and performance. This applies not only to offshore rigs, but to land rigs as well. Depending on the arrangement, this is also true of medium depth rigs, particularly split-rigs or rigs designed for portability. Where a price premium exists, it can be written off in savings in operation over the first two or three years. As the economic advantages are proven by experience it is anticipated that electrification of the drilling industry will proceed as it has in most every other industry during the past several years. —**The End**

New Equipment Designed for Creole's Blowout Control

Continued from Page 104

shipped to Lake Maracaibo for further field testing and crew instruction.

Field testing resulted in several other minor refinements and when these were made, the tool was taken to Creole's Lagunillas Camp where a full-scale test well is set up for crew training. On this rig a miniature blowout was created by pumping water and high volume air into the bottom of a piece of 7-inch casing. Under these conditions, the packer was swung out over the hole and inserted to close off the flow. The test was highly successful, not only because everything worked correctly, but also in view of the fact that the entire insertion and closure procedure occured in approximately 20 seconds from the time the pump pressure was first applied. This time included driving of the packer into the casing, automatic setting of the packer and blowing out of the ball and seat to pump fluid into the well bore.

With the successful completion of this phase of the operation, Creole now plans to set up the same sort of test on an abandoned lake location to learn of any possible difficulties which might be encountered due to water operation and movement of barges or cranes in rough water. If all proves successful at this point, a program will be set up wherein crews will be trained with the equipment and prepared for its use in emergency.

The unit will be stored, eventually, in some convenient location. It will be kept in readiness so that it can be quickly adapted to any size casing and be out on location within two to three hours after the first report of a blowout. Features of the tool, in addition to the highly satisfactory operation, include two other important factors, compactness and lightness. With the packer retracted, overall length of the tool is only approximately 10 feet exclusive of links and elevators. Outside diameter, exclusive of pump-in lines and elevators, is only 12 inches. Weight of the unit, including elevator links and elevators is only approximately 2500 pounds. This low weight makes it adaptable not only to water operations, but also to land operations since it can be handled by conventional-size truck-mounted cranes.

With the completion of the entire testing and training program, Creole's greatest hope is that it will never have to be used. —**The End**

About the Authors

Ortloff

Clark

JOHN E. ORTLOFF, research engineer with the Carter Oil Company at Tulsa, Oklahoma, has a B.S. degree in Mechanical Engineering from Oklahoma A. & M. He served with the Tulsa Winch Mfg., Corp. and Franks Mfg., before joining Carter in 1948. Ortloff is a registered professional engineer and has worked on the development of a hydraulically operated seismic cable handling device, a retractable bit for drilling with casing and the pellet impact drilling with Carter. At the present, Ortloff is on loan to Creole Petroleum Corp. supervising the development and testing of the equipment mentioned in this article.

E. H. (HUBIE) CLARK, chief research engineer for Baker Oil Tools, Inc., is a native of Birmingham, Alabama, and was graduated with honors from the California Institute of Technology with a B.S. in Mechanical Engineering in 1946 and an M.S. in 1947. Clark has served two hitches in the Navy. He has been with Baker Oil Tools for ten years, the last four as Assistant Chief Research Engineer and has only recently been promoted to his present job. Clark has recently returned from Venezuela where he assisted in the field testing of the equipment mentioned in this article.

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A Discussion of . . .

Electric Log Interpretation in Shaly Sands

In keeping with WORLD OIL's policy of publishing both sides to any controversial question, the following discussion is presented as an appraisal and rebuttal of parts of Dr. Sylvian J. Pirson's series of articles on "Formation Evaluation by Log Interpretation," which recently appeared in WORLD OIL.

By LEENDERT DE WITTE
Laguna Beach, Calif.

THE PROBLEM of quantitative interpretation of electric logs in shaly formations attracted much interest over a period of about six years, starting in 1949. Many companies carried out elaborate research programs on the problem. The accumulative results of this research appeared in a series of closely spaced papers by groups from Humble, Gulf, Schlumberger, Continental and Shell. These papers reflected both theoretical electrochemical investigations and detailed empirical work. At the AIME fall meeting in New Orleans in 1955 a special symposium on shaly sands was held, at which fairly general agreement on the solution of the problem by the accumulative research was indicated.

Recently an article appeared which again treated the shaly sand problem. This paper disposed of the electrochemical theories in short order and then without introducing either new theoretical concepts or new empirical evidence, proceeded to offer a different approach to the solution of the problem.

The question arises whether this new approach has indeed superseded the electrochemical theory of log interpretation in shaly formations.

This recent treatment of the shaly sand problem was given by Sylvain J. Pirson[3] as part of a series of articles on "Formation Evaluation by Log Interpretation." Pirson found all previously published methods lacking in either validity or general usefulness and expressed a series of criticisms on all of the past researches. He then described a method which in addition to saturation and porosity also is supported to yield an indication of productivity of the formation. Let's examine Pirson's treatment of the electrochemical theory as presented by the writer[2] in 1955. Under the heading "Continental Oil Company Research Publication" Pirson states: "A set of equations not unlike the modified Archie equation are arrived by pyramiding many assumptions. De Witte suggests for clean sands:

$$ASP = -K_t \log \frac{R_{xo}}{R_t} + 2 \log \frac{S_{xo}}{S_{we}} \qquad (26)$$

and for shaly sands:

$$ASP = -K_t \log \frac{R_{xo}}{R_t} + \log \frac{S_{xo}}{S_{we}} \qquad (27)$$

It is suggested that $K_t = 0.21\ T_f$ where T_f is formation temperature in °R. The range of values of K_t is then 61.5-85. De Witte's formula (27) for shaly sands tacitly assumes a saturation exponent of 1.0 and its range of applicability is between fully developed SP and a reduction factor of 50 percent. Hence it is not applicable to shaly sands with very little SP deflection which are actually the cases of greatest interest."—end of quote.

In the paper concerned two fundamental assumptions are made: The first is that the mobility ratio of the positive and negative ions in the internal solution contained in the porespaces of rocks can be treated as constant. A similar assumption is inherent in all porosity-formation factor relations. The second assumption is that the connate water and mudfiltrate are electrolytes containing only univalent cations (NaCl, Na_2SO_4, etc.). This assumption underlies all presentations of the SP as; $SP = K \log \frac{R_{mf}}{R_{we}}$.

A further lemma stated in the paper, namely that of greatly reduced activity of the counter ions near the surfaces of the dispersed clay particles can be rigorously proven by calculating the electrical field strength in the vicinity of these surfaces. Accepting these premises the Tixier relation is derived directly from the electrochemical description of the system. Inspection of this derivation shows that the two above conditions, namely the constancy of the mobility ratio and the absence of multivalent cations are necessary in order for the Tixier condition to hold true. The Tixier relation is valid only for cases of electrolytes with univalent cations and a given fixed ionic mobility ratio.

Since Pirson uses the Tixier relation as his number 1 postulate, he automatically accepts the same restrictions as those applied in the electrochemical theory under consideration.

The equations (26) and (27) as referred to by Pirson are clearly stated in the original text to be limiting cases of a more general relation of the form:

$$ASP = -K_t \left[\log \frac{R_{xo}}{R_t} + \log \frac{S_{xo}}{S_{we}} + \log \frac{m_R/S_{we} + 2.15\,(S_{xo}/S_{we})m_{mf}}{m_R/S_{we} + 2.15\,m_{mf}} \right] \qquad (a)$$

where m_R is the concentration of the diffuse counter ions of the electrically charged clay surfaces and m_{mf} is the salt concentration of the drilling mud filtrate. Limiting relations are obtained for the following cases:

For clean sands or relatively clean sands and saline muds we have $m_{mf} >> m_R$ and relation (a) becomes:

$$ASP = -K_t \left[\log \frac{R_{xo}}{R_t} + 2 \log \frac{S_{xo}}{S_{we}} \right] \qquad (b)$$

For *very shaly* sands and fresh muds we have $m_R >> m_{mf}$ so that the last term of relation (a) becomes negligible and we may use the approximation:

$$ASP = -K_t \left[\log \frac{R_{xo}}{R_t} + \log \frac{S_{xo}}{S_{we}} \right] \qquad (c)$$

In these relations $K_t \approx 0.21\ T_f$ with T_f given in °Kelvin *(not °R)*. In all of the theory leading up to

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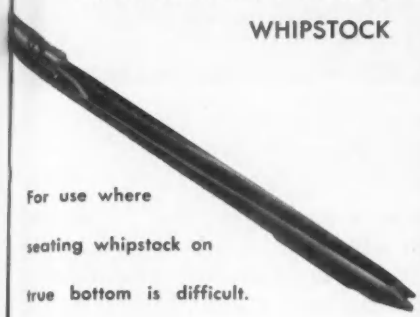

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relation (a) a clean sand saturation exponent of 2.0 *(not 1.0)* is used. In shaly sands the simple exponential relation between saturation and resistivity ratio does not exist and we can at best talk about an *apparent* saturation exponent. Relation (c) shows that in the limiting case for very shaly sands and fresh muds, and when moreover the connate water resistivity is equal to that of the mud we have an *apparent* saturation exponent of 1.0.

Finally, the statement by Pirson that relation (c) has a range of applicability between fully developed SP and a reduction factor of 50 percent and that hence it is not applicable to shaly sands with very little SP is completely unfounded, unsubstantiated and misleading. The only limitation on the applicability is that stated with the derivation, namely $m_R >> m_{mf}$, which requires very shaly formations and fresh muds. In fact the shalier the formation the better the relation is applicable.

Now, let's proceed to a discussion of Pirson's proposed procedure for the evaluation of shaly sands:

Pirson first presents some relations for clean sands (Equations 22, 23) which he labels as "modified Archie equations." Since the equations of Archie do not involve the SP and only treat resistivity relations, and since Equations (22) and (23) are originally due to Poupon, Tixier, Wyllie and others there seems to be little point in referring to them as "modified Archie relations."

The proposed procedure for the evaluation of shaly sands is entirely based on two postulates. As mentioned before Pirson's first postulate is the applicability of the Tixier relation. This relation has been theoretically derived (Reference 2) and experimentally proven, for 100 percent water saturated formations. In oil bearing beds it definitely does not apply. As was pointed out in Reference 2 in oil bearing formations F_a is increased due to the residual oil in the invaded zone and R_{wa} is increased by the effect of oil on the SP. The product F_aR_{wa} will therefore be significantly larger than F_tR_{wc}, so that the first postulate is not valid for oil bearing strata.

The second postulate is of rather unusual form, but its essential features are by no means novel. Pirson assumes that upon invasion there is some fraction of porespace φ_h, that remains occupied by bound water of resistivity equal to the connate water resistivity. A similar idea was used by Tixier[4] in his early paper on Log Analysis in the Rocky Mountains, but has long since been discarded by its author. It has been conclusively shown in the laboratory that upon invasion *all* of the connate water is removed after only very few pore volumes of invading water have passed through the rock. Morgan, Muskat and Russell[5] proved this by using radioactive tracers in the connate water. The writer[6] proved the same point by measuring the total salt content of the effluent water from cores.

The extra conductivity due to dispersed clay is caused by the counter ions of the charged clay surfaces and its effect on the resistivity of the invaded zone has no relation whatsoever to the resistivity of the connate water originally in place. The steps leading from Pirson's assumption to his second postulate are based on the fact that the conductivities of the water fractions should be additive so that:

$$\frac{1}{R_{xo}} = \frac{1}{F}\left(\frac{1-\varphi_h}{R_{mf}} + \frac{\varphi_h}{R_w}\right) \qquad (d)$$

Combining this with $F_a = \frac{R_{xo}}{R_{mf}}$ yields the second postulate.

A relation of the same form as (d) was given in an early paper by the writer (Reference 7), namely:

$$\frac{1}{R_{xo}} = \frac{1}{F}\left(\frac{1-X_w}{R_f} + \frac{X_w}{R_{mf}}\right)$$

where $1/R_f$ denoted the extra conductivity due to the clays. The writer no longer adheres to certain aspects of this early approach since it does not correctly reflect the division of porespace by the conductive and nonconductive media. It has been superseded by the analysis of the problem presented in Reference 2.

In the logging examples Pirson indiscriminately mixes the concepts of irreducible water saturation, bound water, water of hydration and excess conductivity due to clays. At Continental's research laboratory the possibility of a correlation between irreducible water and excess clay conductivity was investigated and it was found that no such correlation exists. Good examples of anticorrelation are siltstones with siliceous or calcareous cementation which may have very high irreducible water content but practically no excess conductivity (e.g. the Delaware formation in the Permian Basin).

The effect of oil saturation on the lowering of the SP curve and that of residual oil on the invaded zone resistivity both of which are neglected by Pirson were thoroughly analyzed and carefully taken into account in the theory leading to relation (a) and the equation for the limiting case of very shaly sands and fresh mud as presented by (c).

Pirson proposes to replace the results of the accumulative research on the electrochemical behavior of shaly sands and of elaborate experimental work, by a procedure fabricated out of an erroneous application of the Tixier equation and the invalid extensions of two obsolete approaches.

In conclusion it may be stated that the recent publications on the shaly sand problem do not offer any new concepts, nor any valid objections to the existing theory. The electrochemical theory as presented in 1955 and the resulting relations for the interpretation of electric logs in shaly sands still continue to be in agreement with all published empirical observations and to satisfy all valid criteria that may be applied to the practical solution of the problem. The theory also should offer a sound basis for the extension of the analysis to cases where multivalent ions reach significant concentrations and for investigations of possible further correlations of the electrical and electrochemical parameters with other properties of the rocks.

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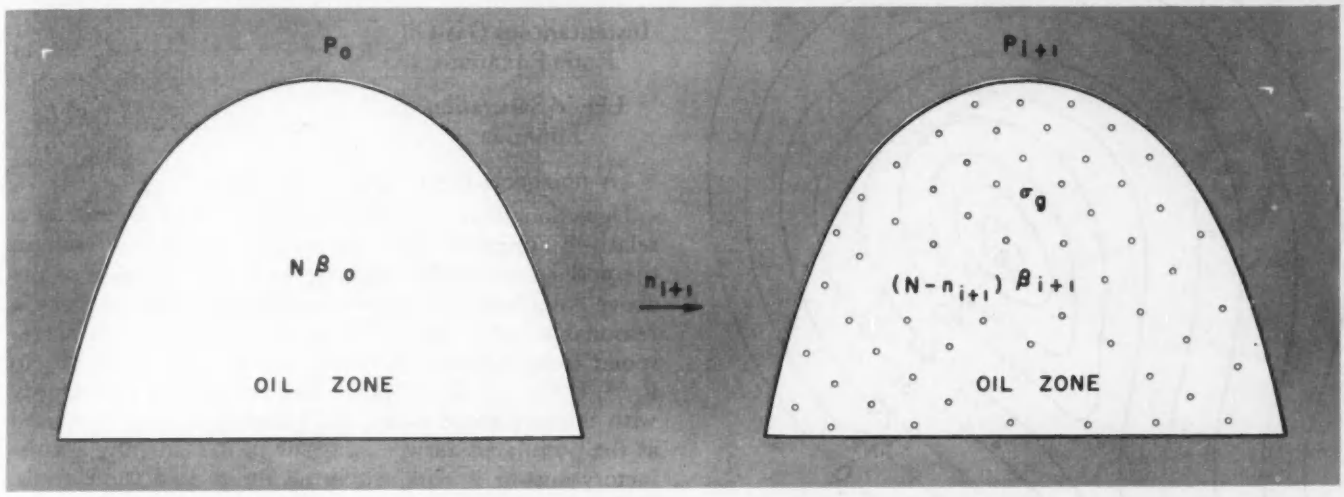


FIGURE 1—Depletion drive is the oil recovery mechanism using the expansion of gas in solution to displace oil from its reservoir rock.

Part 1—Production of Oil by Gas Depletion and Water Drive

A Universal Theory of Oil Reservoir Engineering

Depletion drive is notoriously inefficient in recovering oil. In a water drive field oil recovery can be increased considerably over depletion drive recovery especially if the field-wide production rate is adjusted to an optimum MER value at which field-wide recovery of oil is maximum.

By DR. S. J. PIRSON
The University of Texas
Austin

THERE ARE three fundamental processes by which oil may be recovered from a naturally occurring reservoir—by depletion drive, by water drive and by segregation drive. Any two of the processes may operate in combination: depletion-water drive, and depletion-segregation drive. In such combined operations, each process may be more or less operative in recovering oil from the reservoir and the degree of effectiveness of each process is gaged by means of driving indices. In the most general case all recovery processes may be operative simultaneously to give a combined depletion-water-segregation drive. The study of such a complex operation is the basis of a unified or universal theory of reservoir engineering.

Oil reservoir engineering is the art and science dealing with the forecast and control of the performance of oil and gas production from naturally occurring reservoir rocks in place, with or without the application of an external or artificial source of energy. As a forecaster, the reservoir engineer predicts the performance of field production and the expected recovery under postulated conditions. Such conditions include anticipated possible production rates as well as certain limiting gas-oil ratios or water-oil ratios. In their effort, reservoir engineers use tools which are mainly mathematical in nature.

Reservoir performance of an oil field is characterized by certain essential elements: pressure decline, gas-oil ratio, water-oil ratio, productivity index, production rate, driving index, etc. These elements may be expressed as a function of cumulative production (either on a fractional or volumetric [bbl] basis) or as a function of time. Certain derived elements of the performance prediction are of interest for economic, business, and management reasons; they are cumulative oil, gas, and water production versus time, as well as ultimate recovery and reserves. Production of oil or gas from a natural reservoir involves displacing it from the pore space of rocks which act as the petrologic reservoir within the earth. In recovering oil from porous rocks, there are two fundamentally different displacing mechanisms, namely:

a. depletion drive
b. frontal drive

There are two main types of frontal drives:

a. water drive
b. gas drive

In each of the frontal drives, gravity may or may not

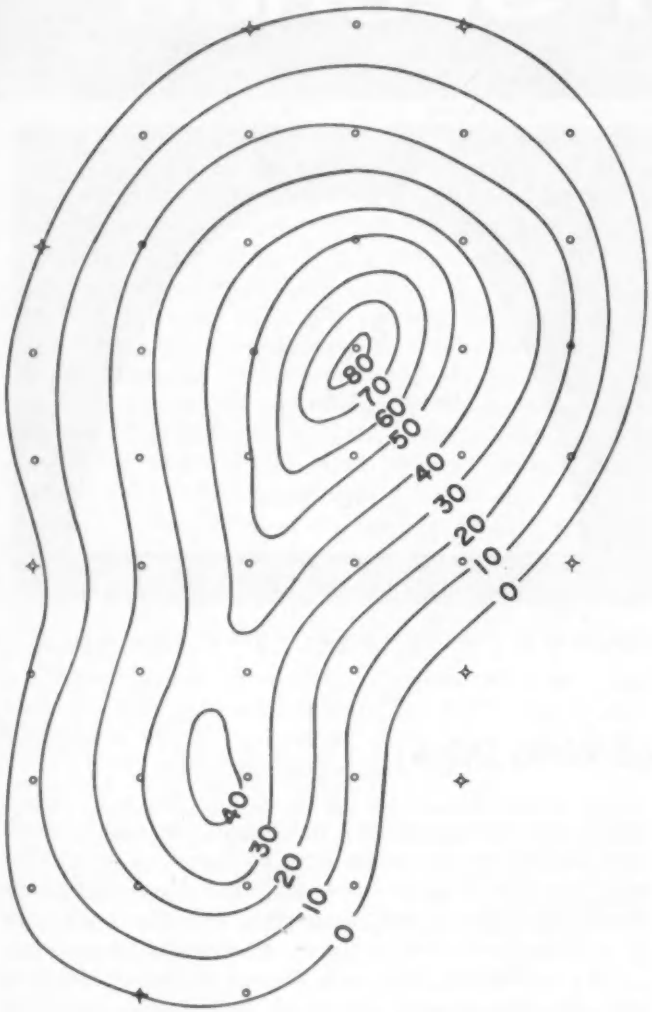


FIGURE 2—The results of the three basic recovery mechanisms applied to this reservoir are used for comparative purposes in this series of articles.

play a predominant part in influencing displacement efficiency and ultimate recovery. It may be so important in certain frontal drive operations as to overshadow the influence of other factors; it is then called gravity drainage.

Depletion Drive (Figure 1) is the oil recovery mechanism wherein the displacement of oil from its reservoir rock is achieved by the expansion of the very gas it holds in solution under pressure. When pressure is reduced on the reservoir oil through the process of drilling, gas comes out of solution and expulses oil from the rock openings. Both oil and gas flow simultaneously through the rocks and their relative flow ability is characterized by the relative permeability of the rock to each phase. These flow properties are paramount in controlling the recovery efficiency by depletion and one of the main tasks of the reservoir engineer in studying this recovery process is determining the appropriate k_g/k_o relationship that will prevail throughout the life of the field.

The tools or mathematical equations which describe this type of reservoir behavior and which are used for depletion drive performance forecast when expressed in finite difference form are the following:

Material Balance Equation:

$$\Delta_i^{i+1} n = \frac{(1-n_i)\,\Delta_i^{i+1}\left(\frac{\beta}{\alpha}-S\right)-\beta_o\,\Delta_i^{i+1}\frac{1}{\alpha}}{\left(\frac{\beta}{\alpha}-S\right)_{i+1}+R_{av}}$$

Instantaneous Gas-Oil Ratio Equation:

$$R = S+\frac{\beta}{\alpha}\cdot\frac{k_g}{k_o}\cdot\frac{\mu_o}{\mu_g} \qquad (1)$$

Liquid Saturation Equation:

$$\sigma_l = \sigma_w+(1-\sigma_w)\frac{(1-n)\,\beta}{\beta_o}$$

(A nomenclature of symbols is appended.)

Depletion drive is characterized by the existence of a relatively uniform fluid saturation distribution within the pore spaces of the reservoir rock. The solution of the above equations is a trial-and-error technique whereby a reasonable value for $\Delta_i^{i+1}n$ is first postulated to correspond to an assumed pressure decline increment (P_i to P_{i+1}). If the calculated value does not check satisfactorily with the postulated value, the calculated Δn is now used as the postulated answer in a new trial. Generally a satisfactory answer is obtained in no more than three trials. The finite difference material balance technique has the advantage of convergence and is highly adaptable to high speed mechanical and electronic computers.

Special cases of depletion drive obtain when attempts are made at increasing recovery through the medium of *dispersed* gas injection. Two cases are possible depending on whether the injected gas is uniformly dispersed throughout the reservoir rock (conformance factor $e = 1.0$) or the injected gas affects only part of the reservoir rock volume ($e < 1.0$).

In the case of uniform dispersion of the injected gas, the depletion drive performance equations remain unchanged except for the inclusion of a multiplier $(1-I)$ to R_{av} in the denominator of Δn, I being the constant fraction of the produced gas which is continuously injected.

In the case of non-uniform dispersion of the injected gas, it is necessary to evaluate on a reasonable basis the fraction (e) or conformable section of the reservoir which is affected by gas injection. This may be done in a certain measure through pore size distribution studies in large cores or better by fitting an appropriate value of (e) to a past performance history. The depletion performance equations now become:

$$\Delta_i^{i+1} n = \frac{(1-n_i)\,\Delta_i^{i+1}\left(\frac{\beta}{\alpha}-S\right)-\beta_o\,\Delta_i^{i+1}\frac{1}{\alpha}}{\left(\frac{\beta}{\alpha}-S\right)^{i+1}+R_{e\,av}\,(1-I)}$$

$$R_e = S+\frac{\beta}{\alpha}\cdot\left(\frac{k_g}{k_o}\right)_e\cdot\frac{\mu_o}{\mu_g} \qquad (2)$$

$$\sigma_{le} = \sigma_w+(1-\sigma_w)\frac{(e-n_e)\cdot\beta}{e\,\beta_o}$$

The subscript (e) indicates that the subject function is to be evaluated in the conformable section of the reservoir.

A special case of depletion with gas injection obtains when pressure is maintained (pressure maintenance operation); this occurs when $I = 1+\frac{\beta/\alpha-S}{R_{av}}$.

Typical performance and recovery predictions have been made for various postulated conditions for the reservoir represented by Figure 2 wherein the influence of

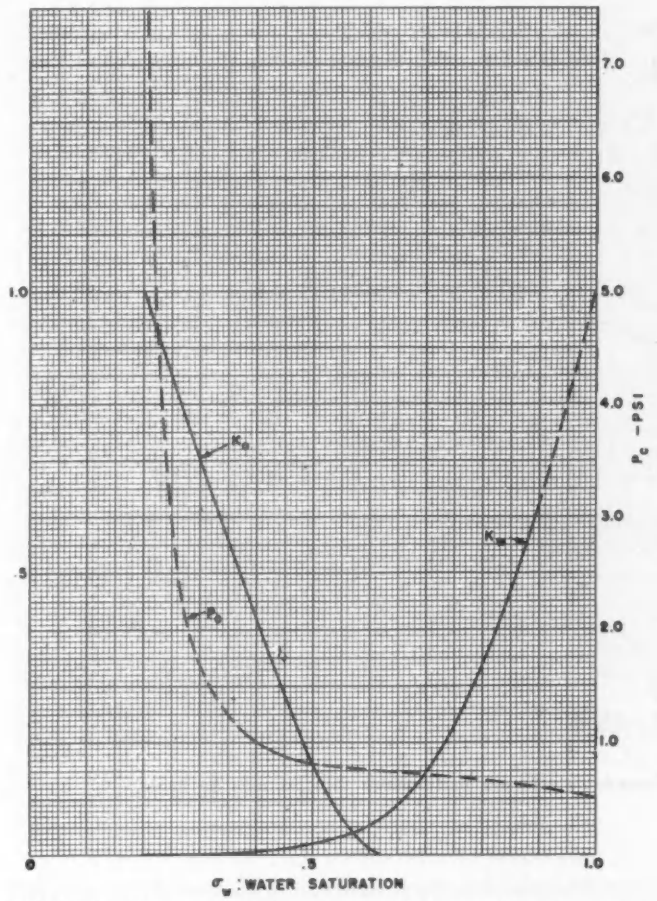


FIGURE 3—Oil-water Relative Permeabilities—Capillary Pressure—The knowledge of the relative ability of oil and water to flow simultaneously through a reservoir rock is needed in making reservoir predictions especially in water drive fields.

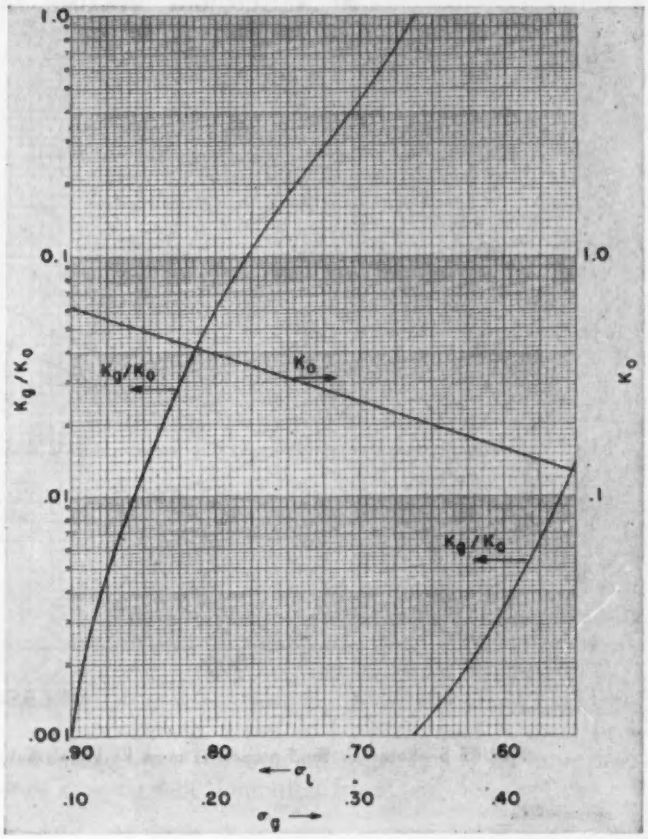


FIGURE 4—K_g/K_o and K_o Characteristics of Reservoir Rock—The relative ability of oil and gas to flow simultaneously through a reservoir rock must be known to predict reservoir performance by solution gas drive (Depletion Drive).

a single variable is illustrated; i.e., viscosity, gas in solution, formation water saturation, etc. The rock and reservoir fluid properties used in the calculations are represented in Figures 3, 4 and 5. Comparative performance curves under various operations are given in Figure 6. In the main, depletion drive is a relatively inefficient oil displacement mechanism; its influence should be reduced as much as possible when the possibility of economic use of other recovery mechanisms exists. In a combination type drive, the influence of depletion may be gaged by means of the driving indices and efforts should be made to reduce the depletion drive index to as small a fraction as possible.

Frontal Drive is the recovery mechanism wherein the displacement of oil from its reservoir rock is achieved by an external driving fluid, either water or gas, and where a sharp saturation discontinuity exists between the driven and the driving fluid at a well-defined line of demarcation or *front*.

The tools, or mathematical equations which are used for frontal drive performance calculations and recovery forecast, are the following:

Fractional Flow Equation:

$$f_D = \frac{1 - \frac{K_o}{q_t \mu_o}\left(\frac{\partial P_c}{\partial u} + g\Delta\delta \sin\alpha\right)}{1 + \frac{k_o}{k_D} \cdot \frac{\mu_D}{\mu_o}} \qquad (3)$$

Rate of Advance of a Region of Constant Saturation: $\left(\frac{du}{d\theta}\right)_{\sigma_D} = \frac{q_t}{\phi}\left(\frac{\partial f_D}{\partial \sigma_D}\right)_\theta$

where D represents any displacing fluid, water or gas.

$$q_t = q_o + q_D$$
$$\Delta\delta = \delta_D - \delta_o$$
$$P_c = P_D - P_o$$

Equation (3) contains all of the factors which have an effect on recovery by water or gas drive, namely, effective and relative permeability, K_o, K_o/K_D, oil and relative viscosity, μ_o, μ_D/μ_o; rate of drive, q_t; capillary pressure gradient ($\partial Pc/\partial u$); gravity, g: fluid density difference, $\Delta\delta$; structural dip (α), and direction of drive with respect to dip (u).

Except for Depletion Drive in volumetric reservoirs, it is seldom that any of the above mechanisms operate singly. Various types of combination drive operations are possible.

Combination Depletion—Water Drive (Figure 7). This type of drive is one in which both Depletion and Water displacement are partially to totally effective in producing oil. The contribution of each mechanism depends greatly on the rate of field-wide oil production (Q_o) as compared to the rate of water influx (C) into the field.

The water influx rate (C), generally expressed in barrels/month/psi pressure drop between field and aquifer, must be determined statistically from a knowledge of an adequate past performance history by means of a generalized water encroachment formula of the type:

$$W_{t+1} = C \sum_{t}^{t+1} P(\theta) \cdot \Delta\theta \qquad (14\text{-}4)$$

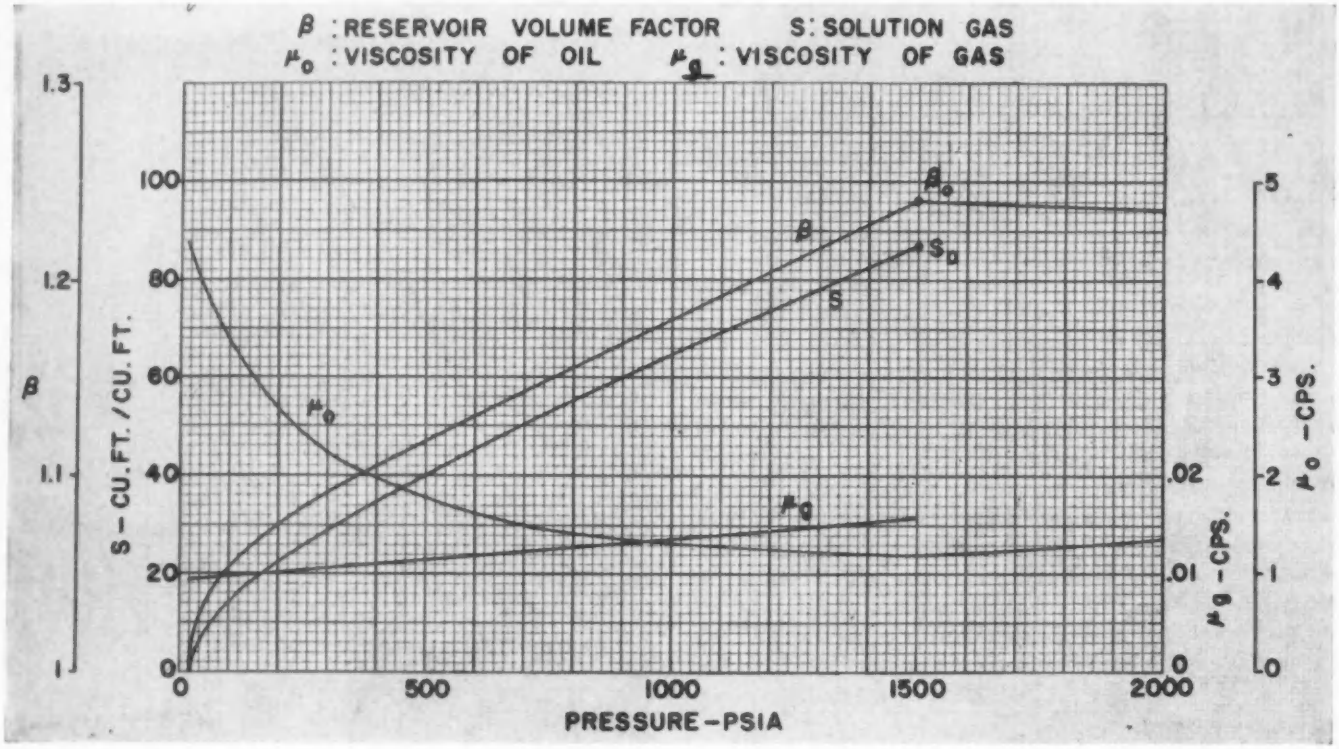


FIGURE 5—Reservoir fluid properties must be known before dependable reservoir performance forecast may be made.

where $P(\theta)$ is a time function which may have the following forms:

Schilthuis	$P(\theta) = \Delta P$
Hurst (simplified)	$P(\theta) = \dfrac{\Delta P}{\log \theta}$
Hurst and van Everdingen	$P(\theta)\ \Delta\theta = Q(\bar{\theta})\ \Delta P$
where $\bar{\theta}$ is dimensionless time obtained from	$\bar{\theta} = \dfrac{K}{\phi\ \mu_w\ c_w} \cdot \dfrac{1}{R_b^2} \cdot \theta$

Performance is calculated on a time basis for preassigned and expected field-wide production rates (Q_o):

$$\Delta_1^{t+1}\theta = \frac{(1-n_1)\,\Delta_1^{t+1}\left(\frac{\beta}{\alpha}-S\right)-\beta_o\,\Delta_1^{t+1}\frac{1}{\alpha}+\frac{W_1-w_1}{N}\,\Delta_1^{t+1}\frac{1}{\alpha}}{\frac{Q_o}{N}\left[\left(\frac{\beta}{\alpha}S-\right)_{t+1}+R_{sv}\right]-\frac{C\,\Delta_1^{t+1}P-C_1}{N\,\alpha_{t+1}}} \qquad (5)$$

Depending on which water encroaching formula is selected, the values of C will be numerically different.

It should be noted that C_1 may include the contribution of artificial water injection or of water disposal by injection into the aquifer.

The simultaneous solution of the depletion equations (1) and of the water encroachment formula (5) determines performance and recovery of a water drive-depletion drive combination operation. The calculations are based on a presumably valid *postulate* that *"the prevailing field pressure determines the fluid saturation conditions in the oil zone, and that these conditions are those of simple depletion drive."* Oil production is presumably obtained from the oil zone alone in a water-drive field.

A characteristic of this type of operation is that field pressure stabilizes when reservoir withdrawal rate and net water influx are equal:

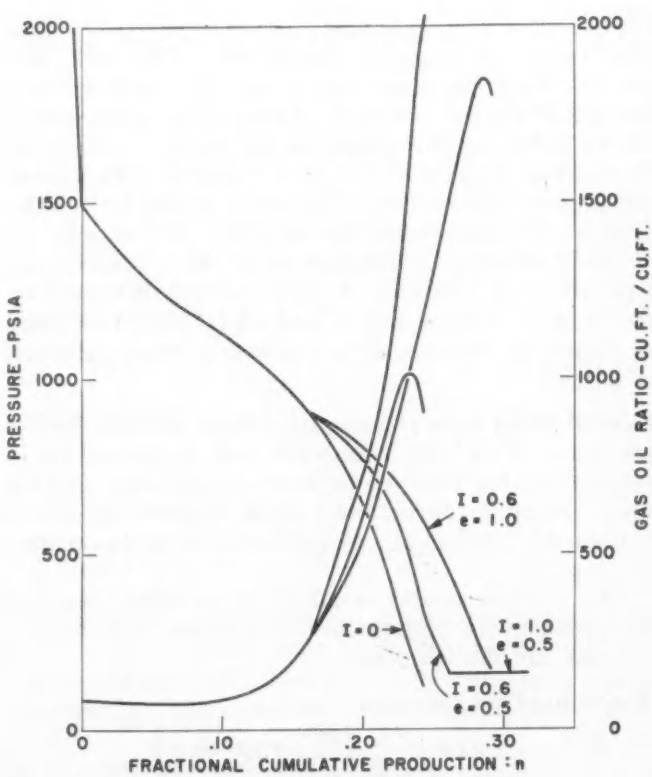


FIGURE 6—Comparative Depletion Drive Performance in the reservoir depicted in Figure 2 showing differences in pressure decline, gas-oil ratio and recovery, under various operating procedure.

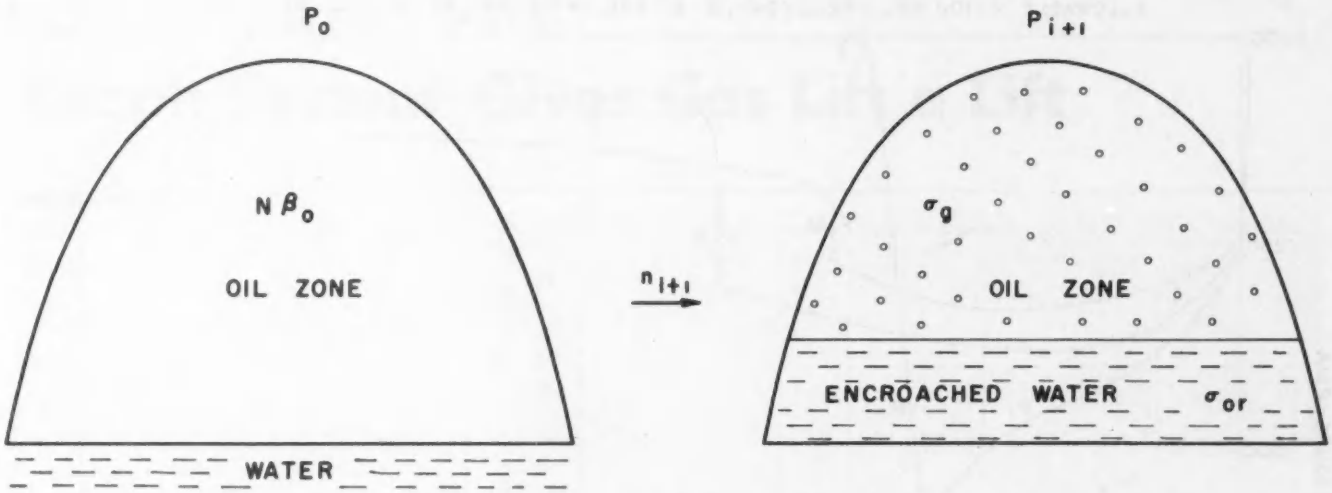


FIGURE 7—Water Drive—One in which both depletion and water displacement are partially to totally effective in producing oil.

$$\frac{C\,P(\theta) - C_1}{\alpha} = Q_o\left[\left(\frac{\beta}{\alpha} - S\right) + R_{av}\right] \qquad (6)$$

In this equation the subscripts are dropped because field pressure is constant.

The field producing rate, Q_o, is a function of the field pressure, of the effective pay (h_e), and of the specific P.I. of the wells.

The *Driving Index* concept is useful in gaging the degree of effectiveness of each mechanism in recovering oil. The driving index may be defined as the volume ratio of the reservoir fluid withdrawals contributed by a particular mechanism to the total reservoir fluid withdrawals contributed by all mechanisms.

On a finite basis, the driving indices are:

Depletion Drive Index:

$$DDI = N\frac{\left[\left(\frac{\beta}{\alpha} - S\right) - \left(\frac{\beta_o}{\alpha} - S_o\right)\right]}{n\left(\frac{\beta}{\alpha} - S\right) + G} \qquad (7)$$

Water Drive Index:

$$WDI = \frac{\frac{1}{\alpha}(W - w)}{n\left(\frac{\beta}{\alpha} - S\right) + G}$$

All subscripts are dropped because all functions and variables are evaluated at the same time. G represents the cumulative volume of gas produced, measured at standard conditions up to a particular pressure.

On a finite difference basis, the driving indices are:

$$DDI = \frac{(1 - n_i)\,\Delta_i^{i+1}\left(\frac{\beta}{\alpha} - S\right) - \beta_o\,\Delta_i^{i+1}\frac{1}{\alpha}}{\Delta_i^{i+1} n\left[\left(\frac{\beta}{\alpha} - S\right)_{i+1} + R_{av}\right]} \qquad (8)$$

$$WDI = \frac{\Delta_i^{i+1}\left(\frac{W - w}{N\alpha}\right)}{\Delta_i^{i+1} n\left[\left(\frac{\beta}{\alpha} - S\right)_{i+1} + R_{av}\right]} \qquad (8)$$

Over-all recovery by both processes for a combination depletion-water drive reservoir is a function of the degree of effectiveness of each process, i.e., of their respective driving indices, but also of the rate of advance of the water front because the displacement efficiency of a water-drive is rate-sensitive. A displacement efficiency calculation should therefore be performed at each pressure decrement. The over-all recovery (r) by both processes may then be computed from:

$$r = \sum_{\circ}^{i+1}\left\{(DDI)\,r_d + (WDI)\,r_w\right\} \qquad (14\text{-}9)$$

where r_d is the recovery by depletion for a specific pressure decrement.

r_w is the recovery by water drive for the same specific pressure decrement.

(DDI) is the depletion drive index on a finite differ-

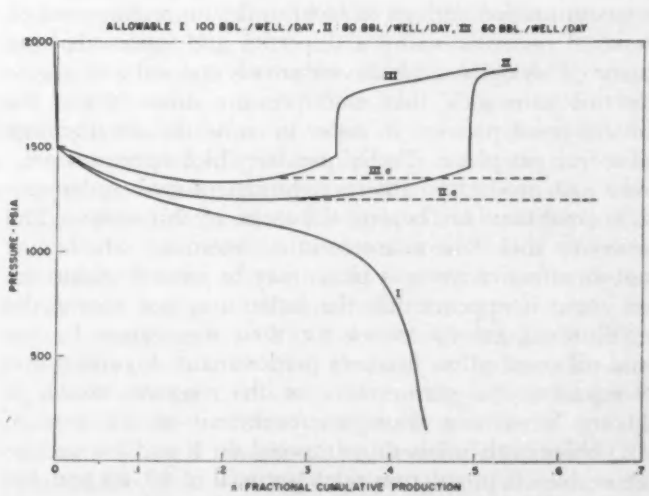


FIGURE 8—Water Drive Performance in the reservoir of Figure 2 on which a natural water encroachment is now imposed. Variable allowable oil production rates per well have major effects on performance and ultimate recovery.

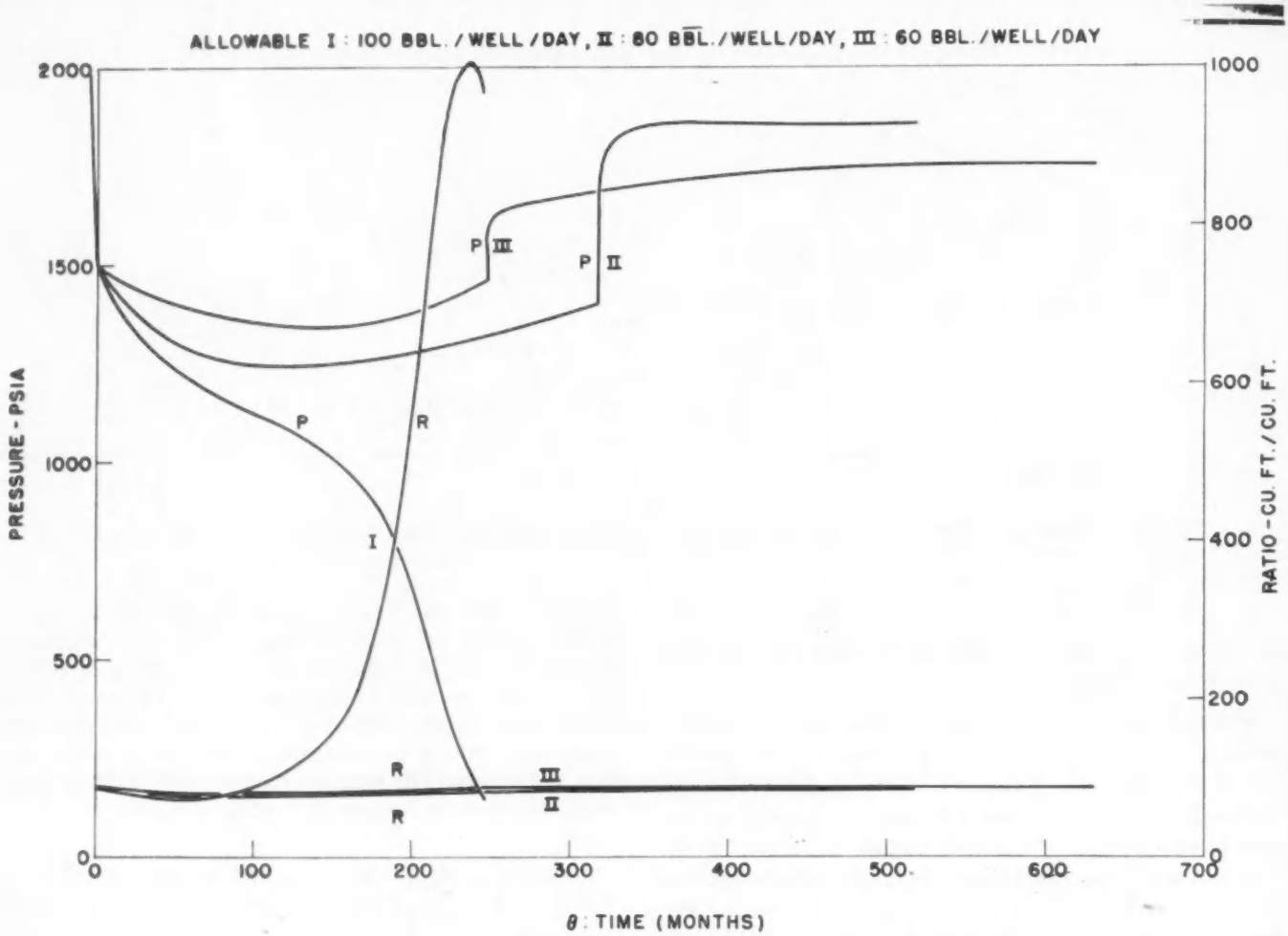


FIGURE 9—Water Drive Performance in the reservoir of Figure 2. A field with a natural water encroachment has a field-wide optimum producing rate at which ultimate oil recovery is maximum.

ence basis over the same pressure decrement.

(WDI) is the corresponding water drive index on a finite difference basis over the same pressure decrement.

Theoretical and laboratory studies have shown that maximum recovery from a water drive field is obtained when field pressure is adjusted by field-wide fluid withdrawals so as to maintain within the overlying oil zone a gas saturation such as to favor optimum replacement of residual reservoir oil by a dispersed and immovable gas phase. This optimum behavior entails operating at a production rate such that field pressure drops below the bubble-point pressure in order to cause the development of a free gas phase. Techniques by which optimum pressure and production rate may be determined under specific conditions are beyond the scope of this review. The reservoir rock flow characteristics determine whether or not an effective free gas phase may be created within the oil zone; it appears that the latter may not exceed the equilibrium gas saturation for then segregation by gas and oil counterflow becomes predominant. Figures 8 and 9 represent the performance of the reservoir shown in Figure 2 when a water encroachment at the rate of 120 bbl/month/psi is superimposed on it and for various allowable oil production rates per well of 60, 80 and 100 bbl/day STO.

The operating conditions favoring maximum physical recovery may be termed *"Engineering MER"*. Such conditions may not necessarily correspond to the *"Economic MER"* which entails considering market, operating cost, and political expediency conditions.

Nomenclature of Symbols Not Explained in the Text

N — original oil in place: stock tank oil units.
Q_o — field wide rate of oil production: STO units per month.
q_o — rate of oil production per well: STO units per day.
n_i — cumulative fractional oil production when field pressure is P_i.
Δ — finite difference symbol indicating the variation in any function when field pressure changes from P_i to P_{i+1}.
β — oil reservoir volume factor, dimensionless.
α — gas reservoir volume factor, dimensionless.
S — solution gas: volume per volume.
0 — subscript designating initial conditions.
o — subscript designating oil.
g — subscript designating gas.
w — subscript designating water.
l — subscript designating total liquid.
av — subscript designating average between P_i and P_{i+1}.
e — subscript designating value of a function in the conformable section of a reservoir.
σ — fluid saturation.
K — permeability: specific or effective: in darcy.
k — relative permeability.
R — gas-oil ratio: volume per volume.
μ — viscosity: centipoise,
P_c — capillary pressure: atm.
f — fraction of displacing fluid in a stream.
δ — density or specific gravity.
ϕ — porosity: fraction.
θ — time: days or months.
A — area of gas-oil interface.
V_g — volume of gas moved to the gas-cap by counterflow segregation.
c_w — water compressibility: atm^{-1}.
R_b — radius of the field: cm.
$Q(\bar{\theta})$ — water influx function: dimensionless.

Part 2 will appear in the October issue of WORLD OIL.

For Your Production File . . . (Part 2)

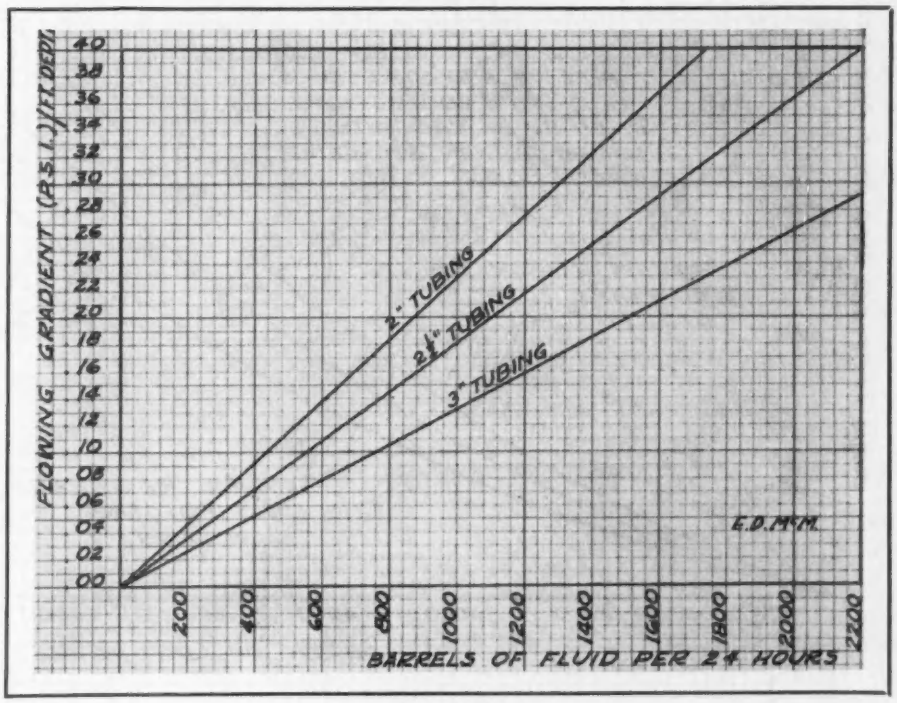
'Graph System' Gives Gas Lift a Lift

By E. D. McMURRY
McMurry Oil Tool Specialties, Inc.
Houston

Much has been written concerning the proper methods of installing gas lift valves in different types of wells. A high percentage of this information can be very helpful in the design of gas lift installations. In many instances, however, the "art" of gas lifting has been presented in such a manner as to make it appear very complicated, requiring numerous formulae and calculations. This is not as it should be. If one basic design principle is understood and a reasonable amount of well information is available, the design of a gas lift installation may be completed easily and quickly.

The graphic method presented here is a condensation of the necessary information required for gas lift valve installation design. It provides, in graphic form, what is really needed for a quick, simple, accurate job. The idea is not new, it was presented over five years ago and now has five years of field application. This engineering too has been tested and found useful by both large and small companies.

The information presented is based on installation of the more widely used "pressure-charged" gas lift valves. The basic reasoning behind any installation is the same, however, regardless of the type of valve used. The practices advocated are based on some twenty years of field experience, the actual installation of several hundred strings of gas lift valves of all types and installation design of hundreds more.



GRAPH A

When using Graph A on wells that will never produce water, and the gravity is above 35 degrees API reduce the flowing gradient by approximately 15 percent. When producing emulsion or low gravity crude oil (20 degrees API or less), increase flowing gradient by 15 percent. Suggested minimum flowing gradient for use in formula is .04.

Explanation of Graph A and the Spacing Formula. Graph A and the formula for spacing valves are based on flowing gradient data compiled from actual flowing bottom hole pressure surveys on gas lift installations over a period of years.

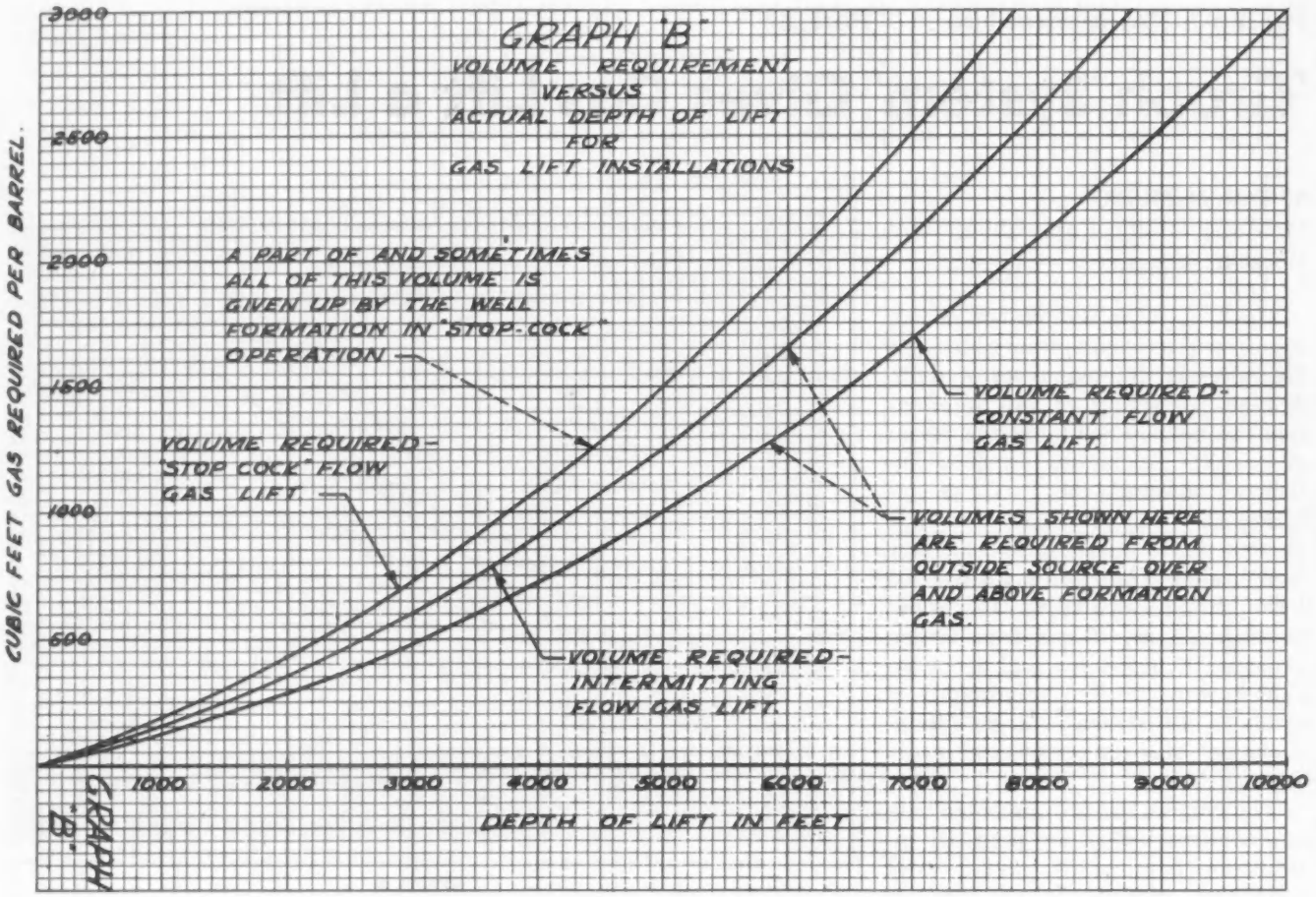
Flowing Gradients. The condition of the tubing wall has quite a bearing on the actual flowing gradient of a well. For example, a well where the tubing is coated with a thin layer of paraffin will produce at a higher back pressure or flowing gradient, at any given rate of flow, than a well with clean tubing. A well tending to make emulsion will produce at still a different flowing gradient under the same conditions. When attempting to calculate a flowing gradient it is next to impossible to consider the condition of the tubing bore.

Graph A takes all this under consideration. The data was compiled with a bottom hole pressure bomb, which picks up these discrepancies under actual well conditions. Practice has proven that, on an average, data shown on Graph A is as accurate, if not more accurate, than calculated flowing gradients.

The information on Graph A was first presented by the author to the producing industry several years ago for use in the spacing of gas lift valves. Now, nearly all gas lift manufacturers use the data, in one form or another, for the spacing of pressure-charged gas lift valves. The results have been excellent and acceptance of the material is spreading rapidly.

The "Graph System" provides a simple means of using Graph A data to establish within reason the flowing gradient, back pressure, or friction loss, whichever it may be called, at each valve under actual producing conditions, as the well is being unloaded to the working fluid level. This, in turn, establishes the producing differential psi across each valve from which the spacing to the next valve may be determined.

Common Error. A static gradient of .5 is used in the spacing formula as a constant, since normally this gradient slightly exceeds the static gradient of the heaviest salt water encountered in oil well production. It must be emphasized that if the flowing gradient is underestimated the installation will not work down the hole as it should. Underestimating the flowing gradient is by far the most common error made in gas lift installation design. It results in a large number of installations being run with valves spaced too far apart. Consequently, although the installation may make its daily allowable it is like an eight-cylinder engine operating on four cylinders. The efficiency will be



low and the input gas/fluid ratios higher per barrel than necessary. Valve life will also be decreased because of abnormally high pressure across the operating valve. (Refer Graph F).

Known Productivity Index. When using the spacing formula where the productivity index is known, the flowing gradient figure entered into the formula will be higher at each valve. (Refer to Graph C). When the PI is unknown, it is common practice to select a flowing gradient in relation to the estimated maximum production rate, using this figure as a constant in the formula. Refer to example of installation design (Condition II) and Graph D.

Flowing gradients illustrated by Graph A are not corrected to include the separator pressure or any abnormal well head pressures due to long or crooked flow lines. These pressures must be entered into the formula or "Graph System" for proper results. This figure is highly variable, but on an average, runs from 75 psi to 100 psi. (Refer to Graphs C, D & E) Graph A eliminates the necessity for attempting to calculate the flowing gradient for each individual well, and greatly reduces the time required to accurately design a proper gas lift installation.

When designing an installation for a well which is not ever expected to produce water and the gravity is above 35° A.P.I., the flowing gradients entered into the spacing formula may be decreased by approximately 15 percent. It is suggested, however, that a flowing gradient of less than .04 never be used, regardless of conditions. The flowing gradient should be increased 15 percent on a well with any tendency to produce emulsion.

Unknown Productivity Index. When the producing characteristics of a well are not known, it becomes a problem of "out-guessing" the flowing gradient in the tubing string. It is wise practice to "guess" toward the heavy side to assure that the installation will work properly down the hole and particularly true if it is necessary to handle volumes in excess of 150 barrels daily.

A reasonable number of valves (usually 6 to 8) then are run to a depth 75 percent under the static fluid level of the well. This practice will, on an average, result in a good, balanced installation, capable of handling the ordinary well satisfactorily. (Refer installation design condition 3).

Types of Installation. There are four well conditions requiring different type installation procedures as shown:

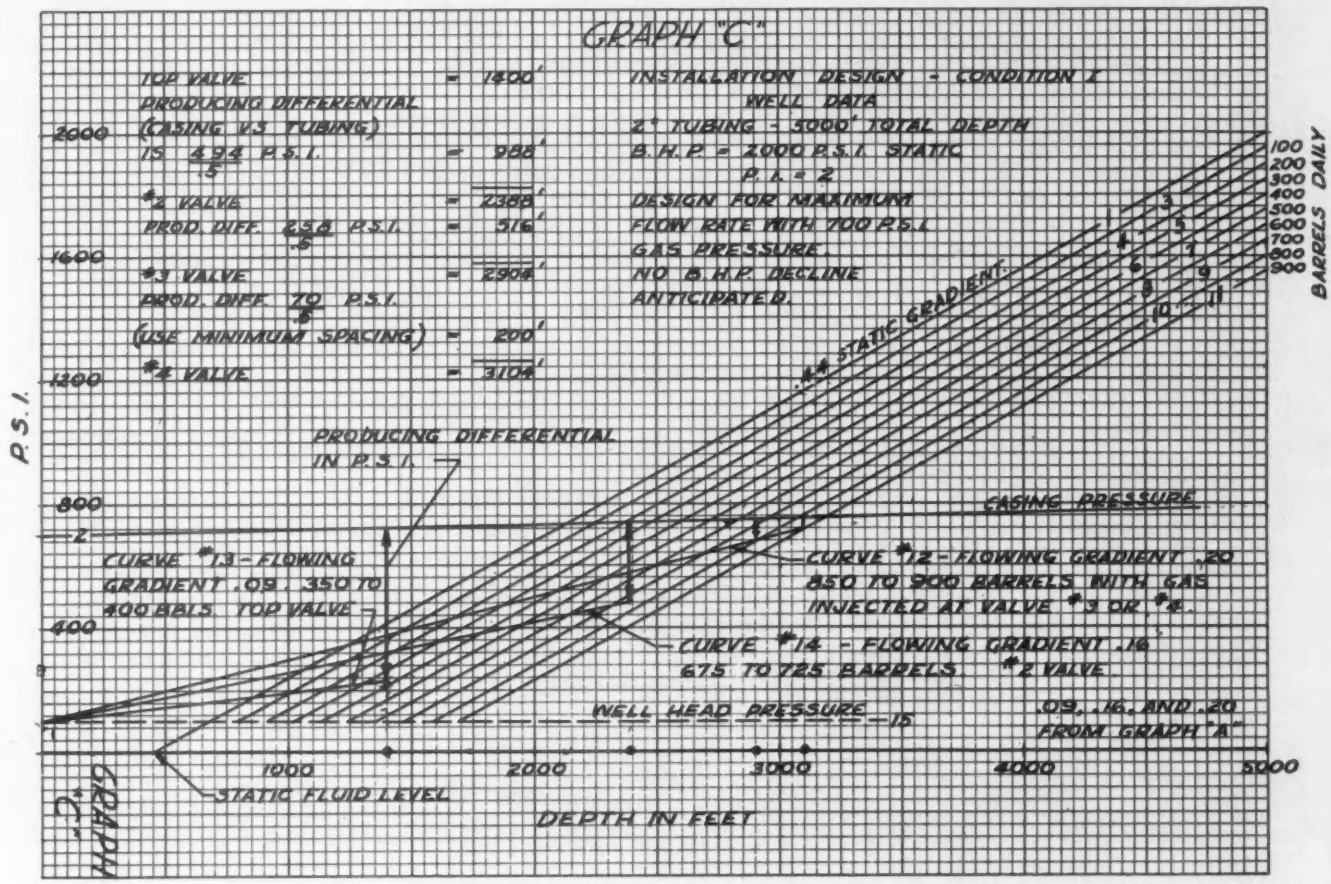
Condition 1. Productivity index KNOWN;

Condition 2. Actual productivity UNKNOWN but, formation characteristics known to the extent that production rate may be anticipated, within reason;

Condition 3. NO PRODUCTIVITY INDEX DATA AVAILABLE, whatsoever.

Condition 4. Any of the above three, where RELATIVELY RAPID BOTTOM HOLE PRESSURE DECLINE ANTICIPATED.

The "GRAPH SYSTEM" is thoroughly dependable except in the case of Condition 3, where lack of information concerning well conditions makes installation design a "guessing



GRAPH C—Curves 12, 13 and 14 were obtained using assumed flowing gradients and correlating with production rate and data on graph "A." It may be necessary to plot more than three assumed flowing gradient curves for each valve before a proper correlation can be obtained.

game" at best. Even so, knowledge gained through use of the "GRAPH SYSTEM" will help when attempting to design installations under Condition 3.

With the "GRAPH SYSTEM" the spacing formula is required for spacing the top valve only under design Conditions 1 and 4. Conditions 2 and 3 require the full use of the spacing formula as no positive PI data is available.

A discussion of installations for each condition follows.

SPACING FORMULAS

FORMULA 1. Use this formula for spacing **top valve only.**

(1-a) Where fluid level of well is less in feet than the U-tube effect of available gas pressure.

$$\frac{\text{Pressure Available}}{.5} = \text{Distance from surface to No. 1 valve in feet.}$$

(1-b) If fluid level of well is greater in feet than the U-tube effect of available gas pressure, place top valve at fluid level in well.

FORMULA 2. Use this formula for spacing all valves except the top valve.

$$\frac{\text{Valve Pressure—Separator Pressure—(Depth of valve above} \times \text{Flowing Gradient)}}{.5}$$

is equal to the distance from valve calculated to next lowest valve.

EXAMPLE

Depth of well.....5000 feet
Available pressure .....650 (psi)
Production desired .....200 Bbls.
Tubing size .....2-inch EUE
Fluid level from surface.....1000 feet
All valves set @.....650 (psi)
Separator pressure .....50 (psi)
No PI data available.

To space No. 1 valve from surface (FORMULA 1-a).

$$\frac{650 \text{ (psi)}}{.5} = 1300 \text{ feet (from surface to No. 1 valve)}$$

To space all other valves (FORMULA 2).

$$\frac{650 - 50 - (1300 \times .05)}{.5} = 1070 \text{ feet}$$

from 1st. valve
No. 2 valve 2370 from surface.

$$\frac{650 - 50 - (2370 \times .05)}{.5} = 964 \text{ feet}$$

from 2nd. valve
No. 3 valve 3334 from surface.

$$\frac{650 - 50 - (3334 \times .05)}{.5} = 858 \text{ feet}$$

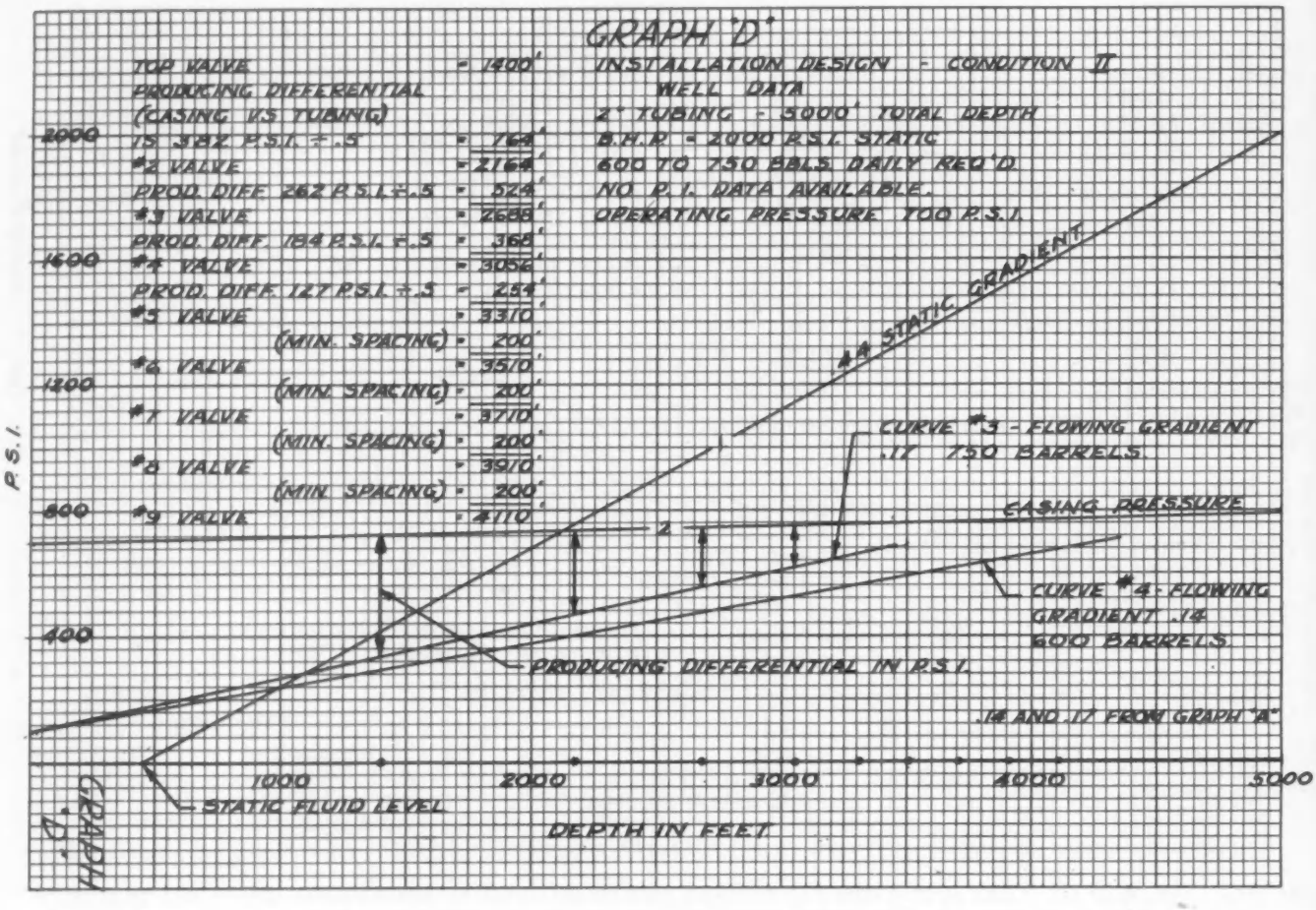
from 3rd. valve
No. 4 valve 4202 from surface.

It is suggested that .04 flowing gradient be the minimum flowing gradient used in the above formula. If the PI of a well is such that the flowing gradient and operating pressure will equalize above bottom, the formula should be followed until valve spacing reaches 200 feet. Any additional valves should be run at this or closer spacing, using personal judgment.

Installation Design (Condition 1)

Productivity known and following well conditions assumed:

Depth of well.....5000 feet
PI 2
Well head pressure.....100 (psi)
No BHP decline anticipated
BHP .....2000 (psi)



Available pressures .....700 (psi)
2-inch tubing

Using graph paper, plot the actual well conditions, (refer Graph C). The curves shown on Graph C are numbered in the sequence in which they were drawn, curve-one being static, curve two the operating casing pressure. The slight pressure increase in relation to depth indicated by curve two is due to gas density. Actually, this curve should 'bend' slightly as the depth increases since the density is greater at the bottom of the casing than it is near the top. For all practical purposes it may be drawn a straight line, as shown.

Next, plot drawdown curves 3, 4, 5, 6, 7, 8, 9, 10, and 11, at 50-pound intervals. These indicate well conditions with 450-pound drawdown. Since the PI figure will remain fairly stable up to 50 percent drawdown, (refer Graph G), the theoretical production rate under curve 2 is (450 x 2), or 900 barrels per day. With flowing gradient data shown on Graph A, and using 100 (psi) tubing pressure as a pivot point, a straight edge moved up and down the graph to plot curve 12 establishes the maximum rate of flow obtainable with the 700 psi gas pressure. This curve must plot so that drawdown, flowing gradient, and casing pressure all correlate within reason. Under the conditions on Graph C, this correlation occurs at a depth of approximately 3100 feet. Therefore, the flowing gradient (.20) (850 to 900 barrels) checks with well's drawndown characteristics at a pressure slightly under that of the operating casing pressure at 3100 feet. This is the maximum depth at which gas can be injected into the tubing string using these well conditions and also establishes the maximum production rate expected from the well.

Spacing No. 1 valve. Referring to spacing formula (1-a):

$$\frac{700\ (\text{psi})}{.5} = 1400 \text{ feet (From surface to No. 1 valve)}$$

To space all other valves, it is necessary to find how much fluid the well will produce from each valve to establish the expected flowing gradient or back pressure psi at each valve.

Again using the 100 psi tubing pressure as a pivot point, plot curves 13 and 14. Make certain that the flowing gradient and drawdown curves correlate with data shown on Graph A. This establishes the back pressure and rate of production at the respective valves. This well will produce approximately 350 to 400 barrels from the top valve with a flowing gradient of .09, or a back pressure of 226 psi. By subtracting the 226 psi from the casing pressure at 1400 feet, 720 psi, the producing differential (pressure drop across the valve) is established at 494 psi.

Spacing No. 2 valve:

$$\frac{494}{.5} = 988 \text{ feet to second valve.}$$

1400 feet + 988 feet = 2388 feet,
(depth of second valve from surface)

The well will produce approximately 675 to 725 barrels from the second valve with a flowing gradient of .16 or a back pressure of 482 psi. By subtracting 482 psi from the casing pressure at 2388 feet 740 psi, the producing differential or pressure drop across this valve is 258 psi.

$$\frac{258}{.5} = 516 \text{ feet to the third valve.}$$

2388 feet + 516 feet = 2904 feet,
(depth of the third valve from surface).

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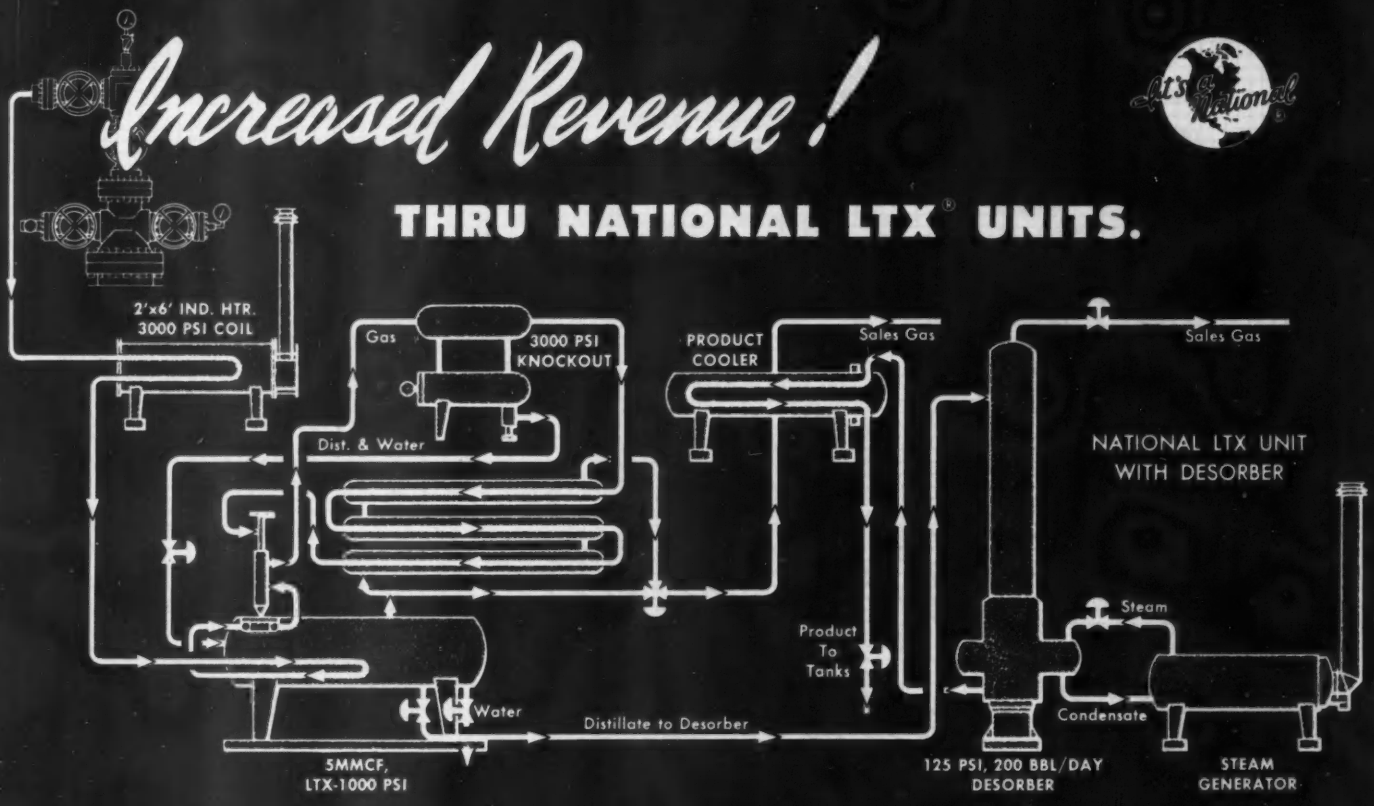

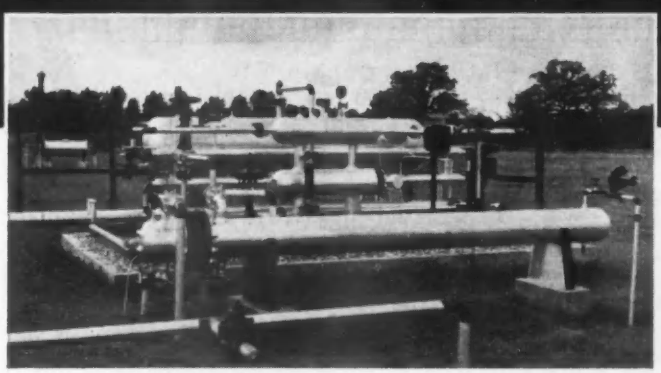

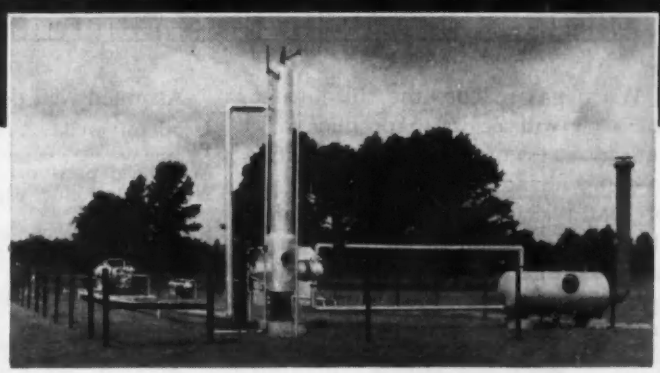

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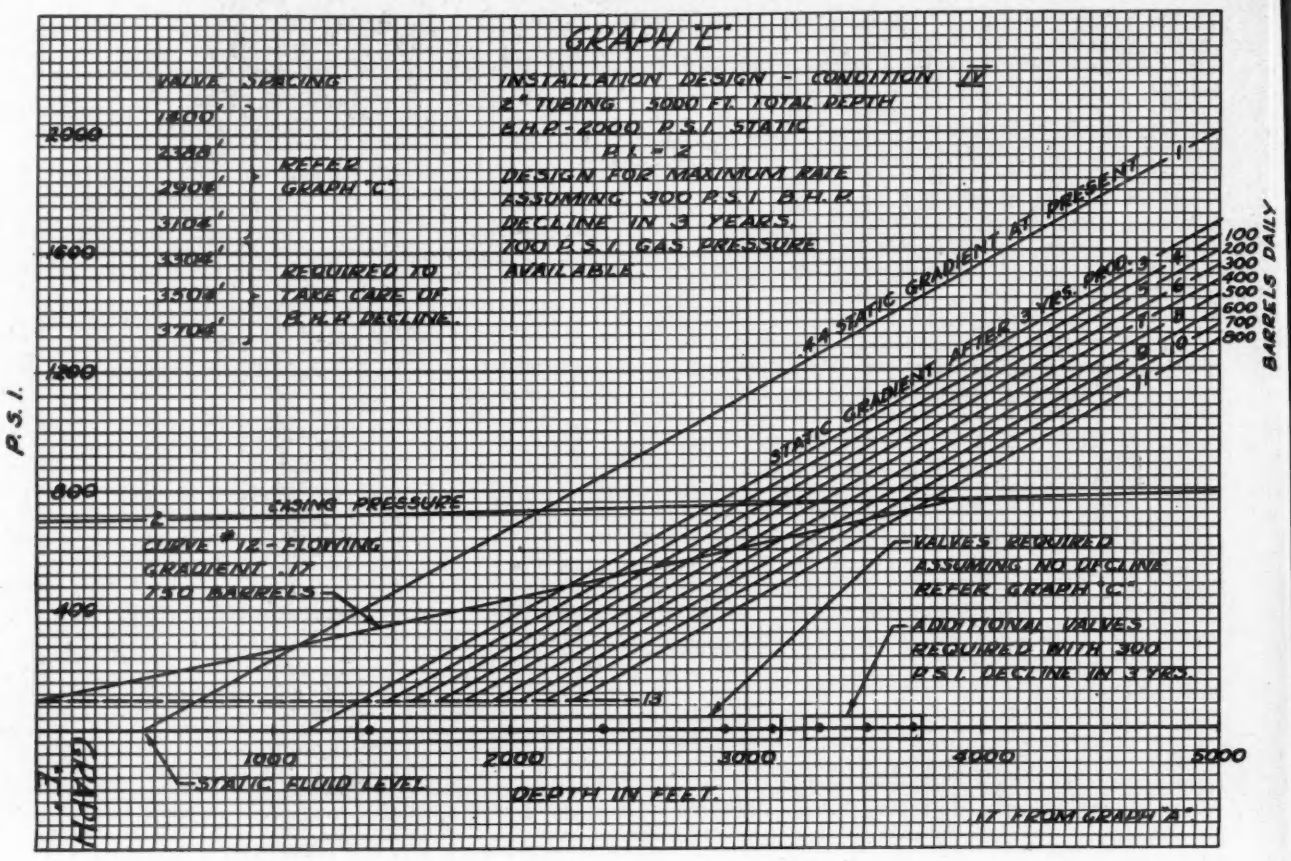

When gas reaches the third valve, the well will begin to produce at a rate in excess of 800 barrels, resulting in a producing differential of 100 psi, or less. The fourth valve is spaced at the minimum spacing of 200 feet or at 3104 feet. A 200 feet minimum spacing is recommended because 100 psi producing differential at the third valve will pick up the fourth valve. A fifth valve may be run at 3304 feet for added safety factor, if desired, should the PI or BHP vary slightly.

In some cases more total fluid will be produced than is actually indicated by the graph because of the gradient below the point of gas injection becoming lighter than when the well was static. This creates additional drawdown, thus more total fluid, and is more likely to occur in wells with high oil percentages. Constant flow valves would be used in this case due to a high rate of fluid delivery. The actual depth of lift in feet at each rate of flow is measured where curve 15 crosses curves 3 through 11. The volume necessary to lift under these conditions is obtained from Graph B.

Installation Design (Condition 2) Where the PI is unknown but approximate production can be estimated.

Assumed well conditions are:

Depth of well.....5000 feet
PI .....Unknown
Well head pressure.....100 psi
No bottom hole pressure decline anticipated
BHP .....2000 psi
Available pressure .....700 psi
Two-inch tubing
Well will produce between 600 and 750 barrels daily.

First, referring to Graph A, the estimated flowing gradient for two-inch tubing at 600-750 barrels daily is .14 and .17, respectively. Referring to Graph D, it will be noted that the two flowing gradients have been plotted versus the operating casing pressures, as shown in curves 2, 3, and 4. Curve 3 and 4 are plotted at a slope of 0.17 and 0.14 psi/foot, respectively. Curve 1 represents the static pressure. This is done to establish the approximate maximum depth of gas injection (where flowing gradient approaches casing pressure within 75 to 100 psi) for each of the different rates of flow.

With this established, the installation design is completed by entering the heavier of the flowing gradients (.17) into the spacing formula. This assures that the well will work down, even if it produces at its maximum rate. Two or three extra valves are run, spaced at the minimum spacing of 200 feet or 300 feet (use personal judgment), to a depth indicated by the maximum point of gas injection with the lighter of the two flowing gradients (.14). This assures that the well will work down to its maximum working depth should it produce at the lower rates of flow. A constant high rate of fluid recovery is not necessary. By reducing the injected gas volume the well can be made to produce at a reduced rate of flow.

Installation Design (Condition 3). Assuming well depth and BHP are the same as in Condition 2, except there is no PI information available whatsoever, the problem is approached as follows: First, establish where to run the bottom valve by placing it 75 percent under the static fluid level. With 2000 psi static pressure at 5000 feet, assume a static gradient of (.44) gives a fluid level of 450 feet from surface or, 4550 feet of fluid in the well. Seventy-five percent of 4550 feet=3412 feet+450 feet to surface = 3862 feet, approximately the point to place the bottom valve. The reasoning behind this is that if the well is drawn down to the last valve which is 75 percent under the static level and still does not produce its allow-

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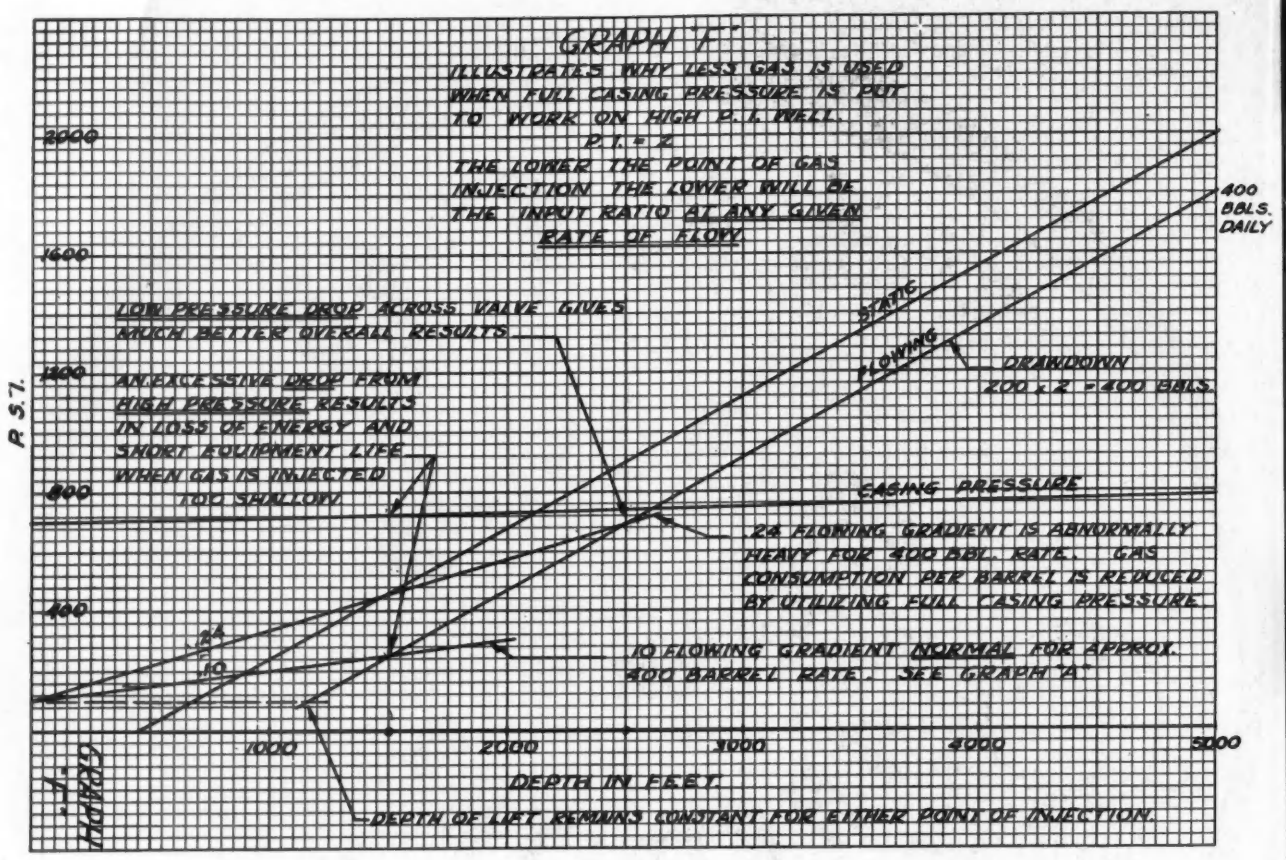
GRAPH F
ILLUSTRATES WHY LESS GAS IS USED WHEN FULL CASING PRESSURE IS PUT TO WORK ON HIGH P. I. WELL.
P.I. = 2
THE LOWER THE POINT OF GAS INJECTION THE LOWER WILL BE THE INPUT RATIO AT ANY GIVEN RATE OF FLOW
400 BBLS. DAILY
LOW PRESSURE DROP ACROSS VALVE GIVES MUCH BETTER OVERALL RESULTS
AN EXCESSIVE DROP FROM HIGH PRESSURE RESULTS IN LOSS OF ENERGY AND SHORT EQUIPMENT LIFE WHEN GAS IS INJECTED TOO SHALLOW
STATIC
FLOWING
DRAWDOWN 200 x 2 = 400 BBLS.
CASING PRESSURE
24 FLOWING GRADIENT IS ABNORMALLY HEAVY FOR 400 BBL. RATE. GAS CONSUMPTION PER BARREL IS REDUCED BY UTILIZING FULL CASING PRESSURE.
10 FLOWING GRADIENT NORMAL FOR APPROX. 400 BARREL RATE. SEE GRAPH "A"
P.S.I.
2000
1600
1200
800
400
1000
2000
3000
4000
5000
DEPTH IN FEET
DEPTH OF LIFT REMAINS CONSTANT FOR EITHER POINT OF INJECTION.

able, trouble lies with the formation and not with the installation.

Once it has been established where to set the bottom valve it is strictly a matter of personal judgment as to how many valves should be run in the installation since no PI is available. Referring to Graph A, a flowing gradient is selected at random to enter into the spacing formula. The lighter the flowing gradient, the less chance of working down the hole. A heavier flowing gradient requires more valves but gives better assurance that the well will perform satisfactorily.

Under such conditions it is more beneficial to run two extra valves than not enough. In many cases, an ample number of valves are run but the tendency is to run them completely to bottom rather than just 75 percent under static fluid level. Running valves to bottom usually requires the selection of a very light flowing gradient with which to figure the spacing. This results in very wide spacing of the valves and consequently the installation does not give proper results.

In conclusion, to design an installation under Condition 3, simply run a normal number of valves (usually six to eight), 75 percent under the static fluid level, using the heaviest possible flowing gradient from Graph A in the spacing formula.

Installation Design (Condition 4). Installation design under Condition 4 covers the method of spacing valves where a bottom hole pressure decline is anticipated. The same conditions as set forth under Condition 1 are assumed, with the exception of an anticipated bottom hole pressure drop of 300 psi over a three year period. Installation design will take this eventuality into account.

First, refer to Graph C, which shows the installation to consist of four valves to handle approximately 900 barrels daily from this well. Compare Graph E, which shows the well conditions three years hence, with 300 psi decline. Plot the static pressure curves 1 and 3, input gas pressure curve 2, and drawdown curves 4 through 11. Using the 100 psi tubing pressure as a pivot point, plot curve 12 so that it correlates with well drawdown characteristics and the flowing gradient data of Graph A. It will be interesting to note that the correlation originally took place at approximately 3100 feet with a rate flow of 850 to 900 barrels (flowing gradient .20), and static pressure of 2000 psi. A static pressure reduction to 1700 psi shows the correlation now at approximately 3700 feet at a rate of flow of about 750 barrels (flowing gradient .17). It becomes obvious that the point of gas injection will move down the tubing string approximately 600 feet over the three year period. To cover this situation, three valves are added to the installation at the minimum spacing (refer Graph E). It may be well to mention again that 200 feet is used as a minimum spacing simply to assure that 100 psi producing differential will lower the fluid level in the casing to the extent of picking up the next valve down the hole. Graph F, illustrates why it is beneficial to keep the point of gas injection as deep as possible on a high PI well.

"Graph System" Installation Design Summary. Once familiar with the "Graph System" of installation design, the complete process should not require over thirty minutes time for computation. Through use of the "Graph System" it will soon become apparent whether certain rates of flow can, or cannot, be obtained with any given operating pressure or set of conditions. For example, by plotting Curve 2 last, it can be determined how

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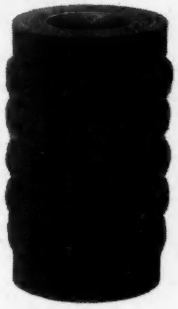

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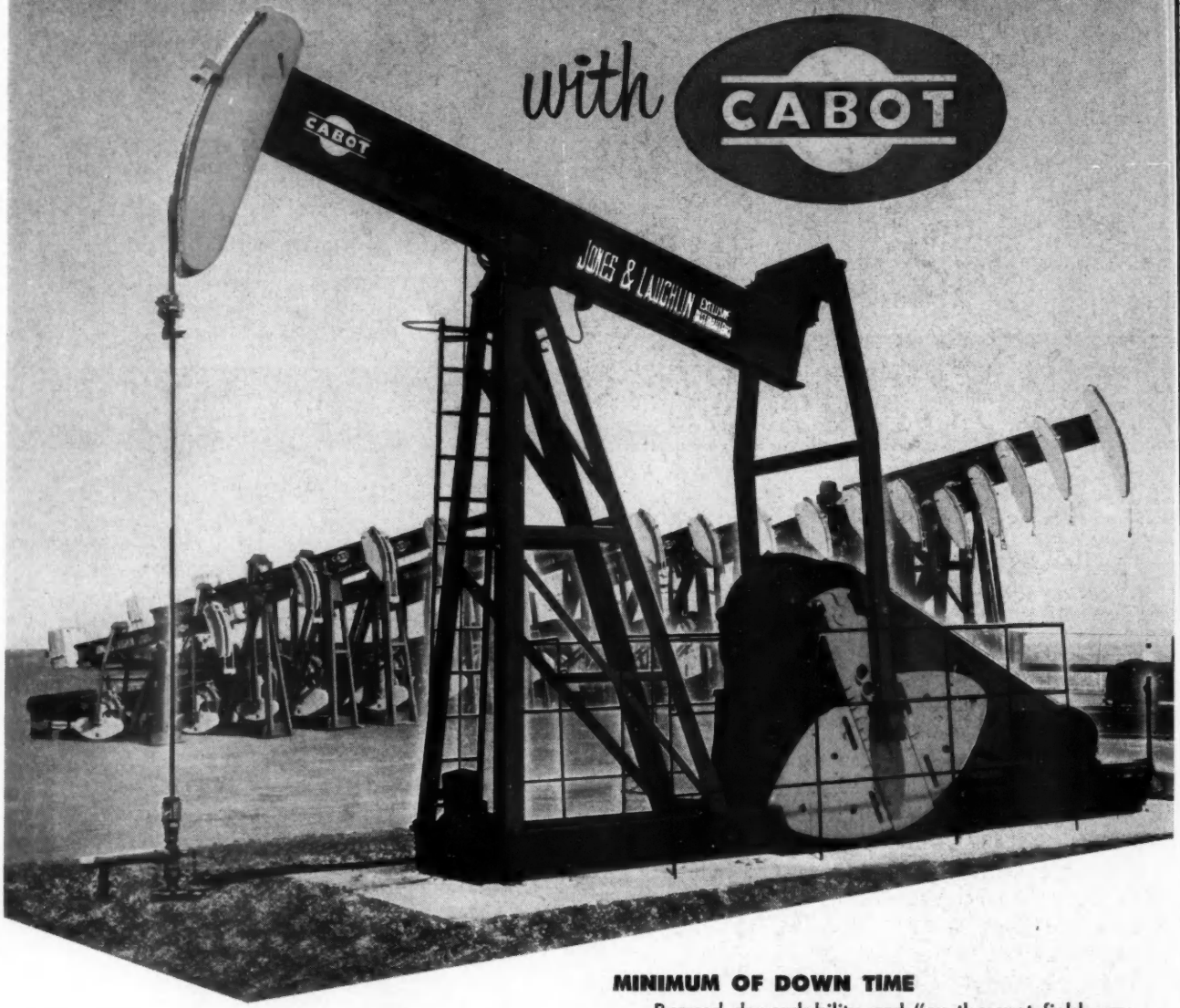

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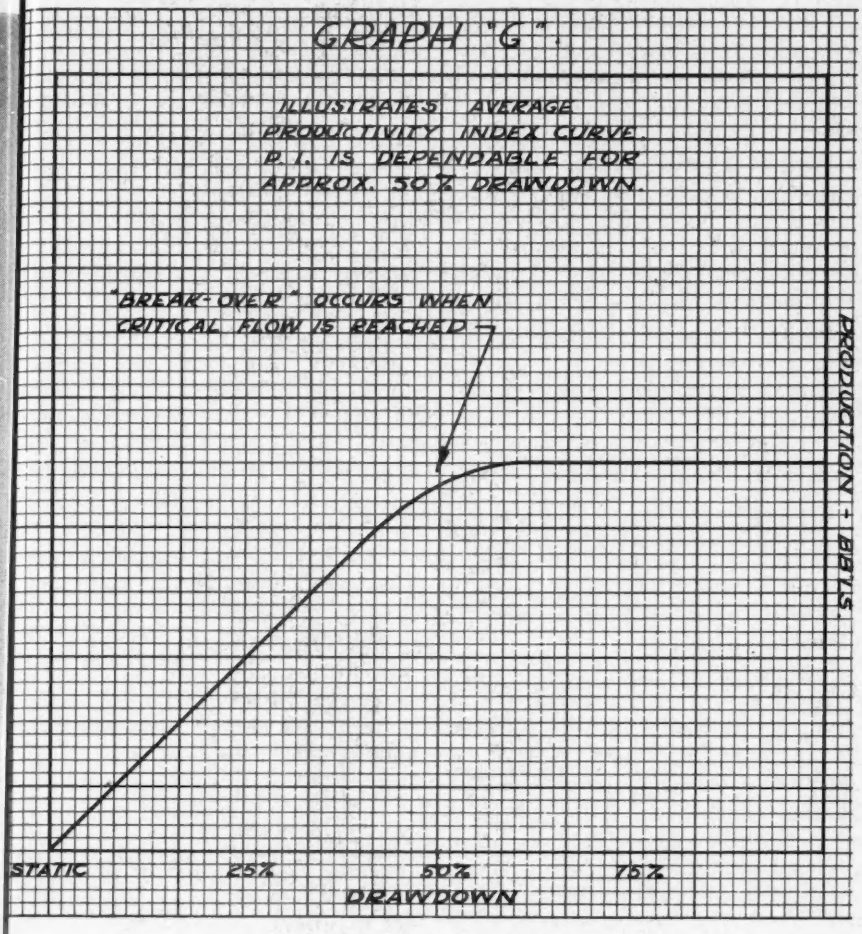
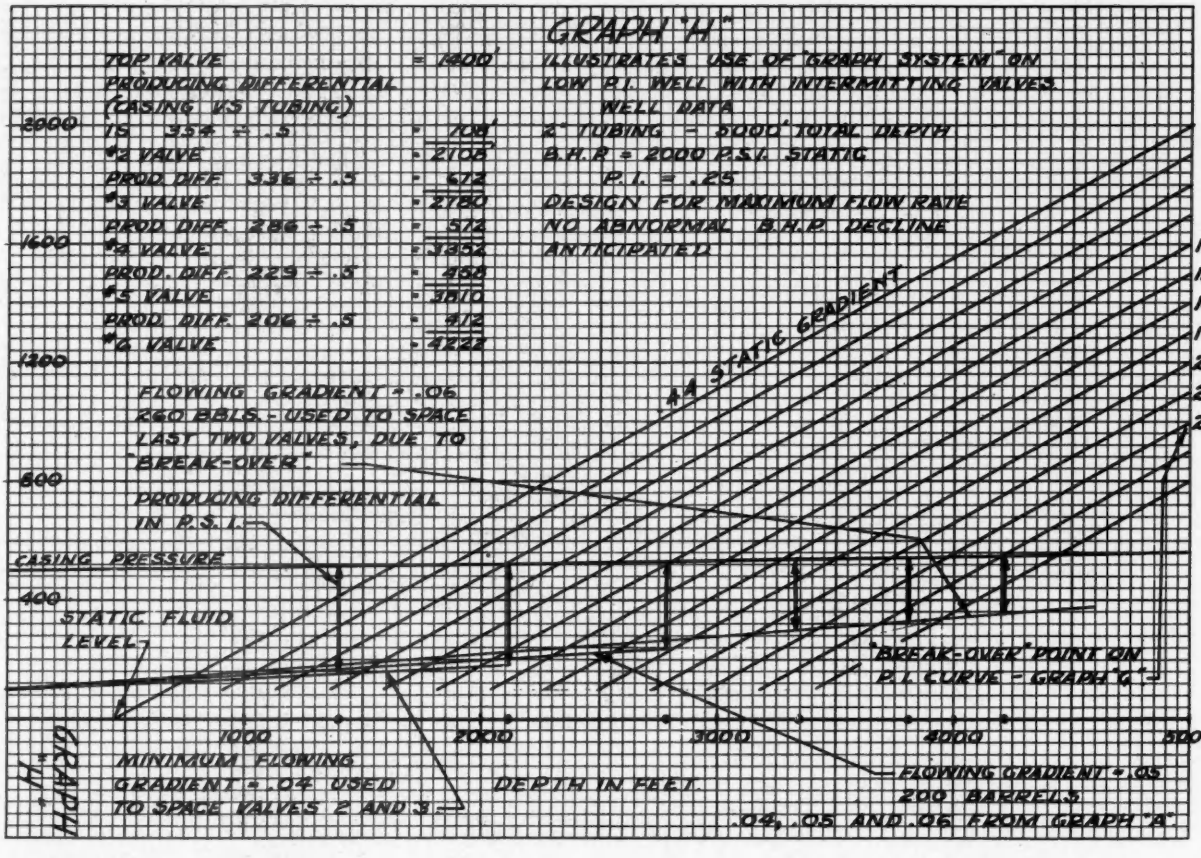


much pressure is required to lift a given amount of fluid from a given depth.

When using the "Graph System" with the operating pressure of each of the gas lift valves reduced, Curve 2 representing the operating pressure, should be reduced accordingly. The practice of "stepping down" the operating pressure of each valve can result in considerable loss of fluid recovery when a well has a good to high PI and is being produced deep in the hole. Since most gas lift systems are limited on pressure, it is desirable to utilize as much of the available pressure as possible.

It is possible to space valves in the tubing string in relation to given rates of flow by use of the "Graph System," if desired. This is required only when rates must be closely controlled. The flowing gradient curves in the "Graph System" are always plotted as a straight line because they indicate the minimum pressure that will exist opposite each valve under actual producing conditions. Thus, the "Graph System" can be applied to constant flow, intermitting and "stop-cock" installations with equal ease and assurance of good results. Graph H applies the "Graph System" to the installation on a well with a low PI.

Part 3 will appear in the October issue of WORLD OIL



New Fracturing Tool Increases Injection Rate

A NEW FRACTURING technique has been introduced by one company utilizing a downhole power-boost tool that generates 5000 hydraulic horsepower. Pumping force by surface equipment is aided with the new tool, displacing fluid into the formation at higher injection rates and pressures instantaneously when the propellant fuel is ignited. The tool has been field-tested to prove its mechanical operation, hydraulic performance, and safety in a variety of actual well conditions. The technique increases the force applied against the formation and makes possible break-down pressures, often not possible with average surface pumping equipment. The high-pressure force exerted against fluid in the tubing minimizes friction and fluid losses, previously a great problem when fracturing through tubing in deep wells.

The new tool can be used with 5½-inch or 7-inch casing and is run in on the tubing string with a packer set above the perforated zone to be fractured. At the beginning of the operation, normal fracturing procedure is followed with fluid being pumped by surface equipment. When fluid reaches the zone to be fractured, the tool is fired by a triggering plug inserted into the frac-fluid stream. When the plug enters the tool, it compresses a firing cam and detonates blank cartridges which initiate the controlled burning of a gas-generating fuel. Gas generated in the firing chamber exerts a downward surge against fluid in the tubing instantaneously under high pressure producing a force creating fractures in the formation. The fracture is continued by pressure supplied from the surface pumping equipment following the tool's exerted hydraulic horsepower on the formation.

Fuel used in the new tool is a solid propellant that burns at a controlled rate when fired. Increased temperature and pressure increases the burning rate of the fuel, but this can be controlled by proper fuel composition for applicable cases. The fuel is not explosive and will withstand a temperature of 300° F. and 10,000 pounds per square inch before detonation, thus the chamber can generate a high injection force without creating an explosive force in the well. The fuel is insensitive to shock and burns with difficulty until a high temperature ignition charge and confinement releases the energy.

In testing the new technique in the field, it was subjected to a wide range of well conditions and problems. Although fracturing improvement was measurable, the well conditions showed no improvement in production increase. But the company maintained these conditions were "incurable."

The tool will generate gas at pressures exceeding the tubing pressure by 1000 psi. It is capable of giving an injection rate of about 2900 gallons per minute at 3000 psi which is the force measured at 5000 hydraulic hp.

The packer and new tool should be set a distance above the perforations equivalent to the anticipated displacement volume of the tool. The anticipated displacement at various pressures can be predicted from a constant pressure-volume relationship. Since the tool displaces 16 cubic feet at 3000 psi, the constant is equal to 48,000. Any pressure can be inserted and the volume anticipated from PV = 48,000. —**The End**

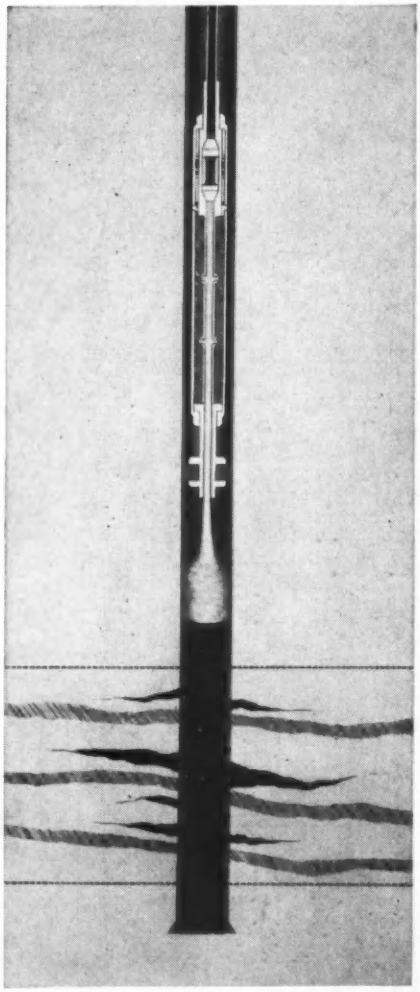


FIGURE 1—View of the technique employed with the new fracturing tool after the firing head of the tool has been tripped. The propellant produces a large volume of gas building up high pressure inside the tool chamber which then is released on top of the frac-fluid in the tubing producing an instantaneous high pressure on the formation being fractured.

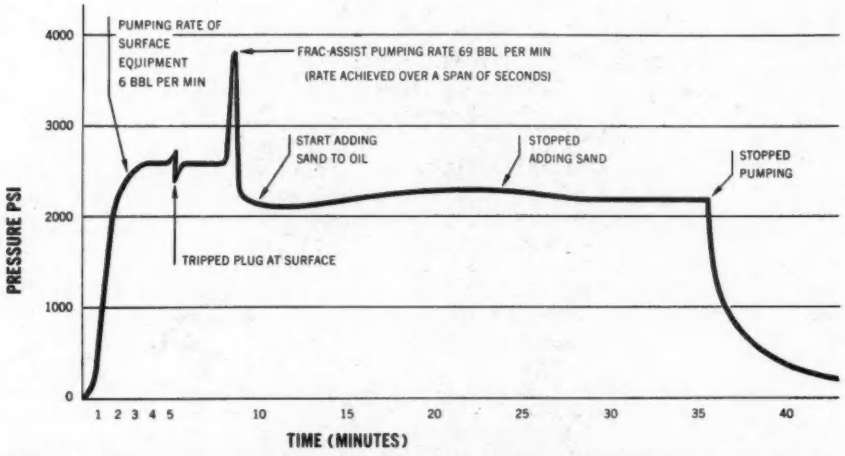


FIGURE 2—Additional fracturing power produced by the new tool and technique employed is demonstrated by this performance chart.

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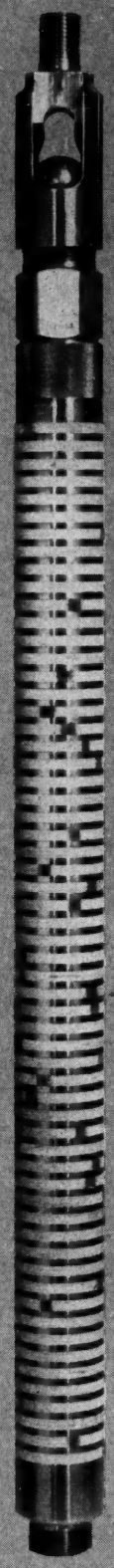

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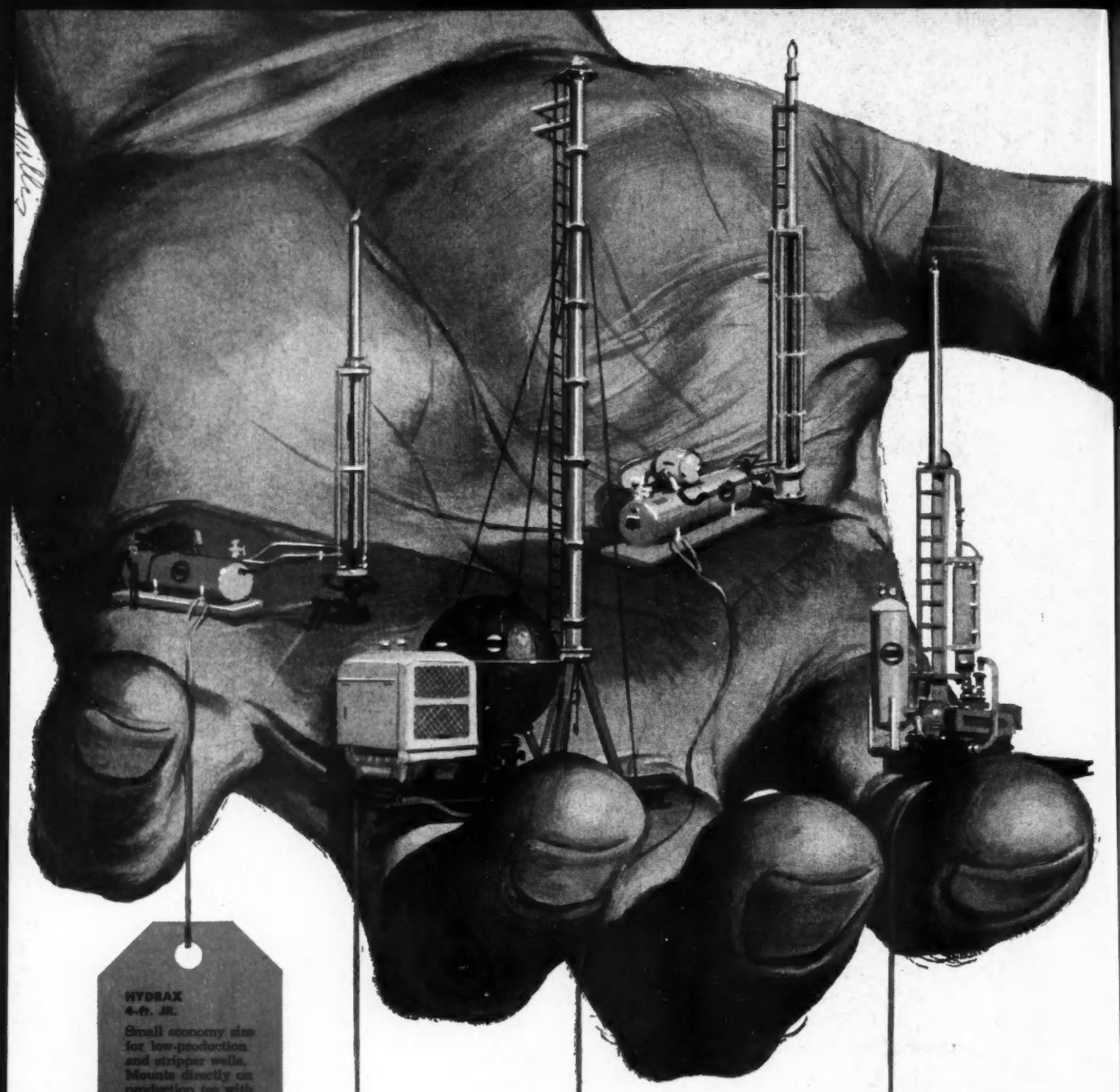

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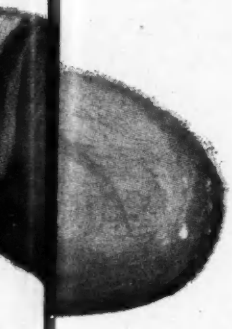

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Production Testing of Electrified Wells

This short and simple production testing procedure is used to determine a well's most efficient pumping cycle.

By JOHN W. LAMBERT
Lambert Engineering and Metering Company
Borger, Texas

WITH PRODUCTION COSTS constantly increasing and unmatched by an equal increase in the cost of crude, it is becoming increasingly important that the oil production industry have available an accurate, economical and dependable method of checking a well's production.

Several methods have been in use for some time, the oldest and simplest method being the use of a test tank at the well location. Even though accurate, these tanks are too expensive to leave at the well. The equipment and man-hours required to haul, connect, and disconnect plus the time required to transfer fluid makes test tanks expensive. A separate test tank installed at the tank battery saves the haul but usually requires quite an elaborate flow line system in order that each well may be individually tested. There are other methods and equipment available to the producer for well testing but these are usually quite expensive.

This new procedure was developed in order to obtain an accurate low cost per well production analysis. Basically there are three steps in the test:

1. Installation of a graphic watt demand meter in the motor control circuit.
2. Sample the well's production at definite points as indicated on the graphic record obtained in Step 1.
3. Determine the volume and weight of each fluid sample obtained and follow the procedure outlined to determine the percent oil and water being produced when the sample was taken.

The use of a graphic watt demand meter has been previously discussed in trade literature[1] but information gained through use of this meter has not heretofore been used as a basis for determining production.

(Step 1.) The graphic watt demand meter having a maximum of 6 KW on the chart has proved very satisfactory in the Texas Panhandle. Here wells, 3000 to 3500 feet in depth, are pumped an average of 16 to 36 inch strokes per minute. Although peaks considerably greater than 6 KW are hit during the pumping cycle, it must be remembered that the instrument used has an approximate 15 minute time lag and therefore averages out the power demand during this period. Thus far, only one well has been found which used the full scale chart reading. The meter should be attached immediately behind the fuses in the motor control box and allowed to record the electrical demand of the motor for 24 hours or more. There is an increasing demand for meter socket bases, permanently connected in the control circuit. By this means a pumper could plug in a socket based demand meter at any time for a periodic check of the well's operation.

(Step 2.) In rare cases where a well is pumping at a constant rate throughout the 24 hour period, a smooth curve will be shown on the chart. However, when there is a change in the amount or density of fluid being pumped this change will be reflected by a corresponding increase or decrease in electrical demand as shown on the chart. At each point where a change is indicated a sample is taken of the fluid being pumped. The amount of sample taken will depend upon the rate of production but very rarely will it exceed five or six gallons of fluid. For ease of calculation it is customary to let the well pump into the sample container for one to four minutes. The volume of fluid in the container can be converted into a production rate after the entrained gas escapes and the fluid settles to a constant level.

(Step 3.) In this step the principle problem is to get an accurate net weight of the sample taken. In order that an accurate percentage figure can be obtained, it is necessary to know the API gravity of oil being produced and also the density of salt water encountered at the particular well.

The API gravity can easily be determined by weighing a known volume of oil. It is also necessary to weigh a known volume of salt water which can be obtained from the tank battery. Then by reference to a chart, similar to that shown in Figure 2 the percentage of oil in the sample is easily obtained. The necessity for accurately determining the volume and weight of the sample taken cannot be over emphasized. Since the chart accompanying this article is based on the determination of a mixture of two fluids of known densities, accurate readings are necessary to obtain accurate percentage figures. The procedure outlined, when properly followed, will show at what time in the pumping cycle a known rate of oil or fluid is being produced. These known rates, multiplied by the time

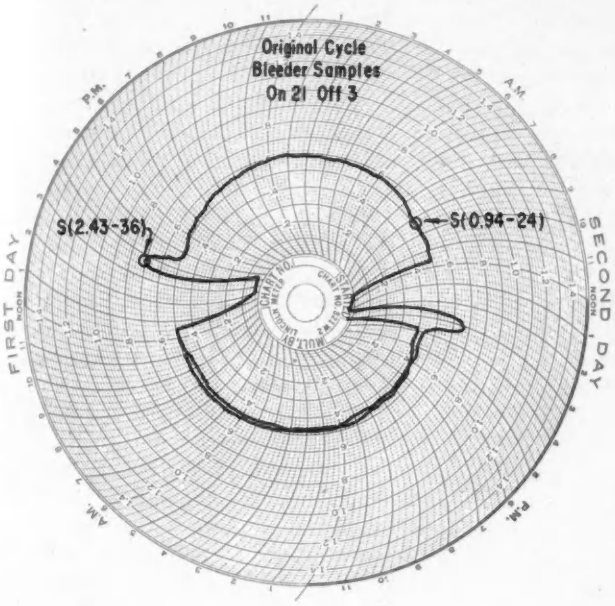
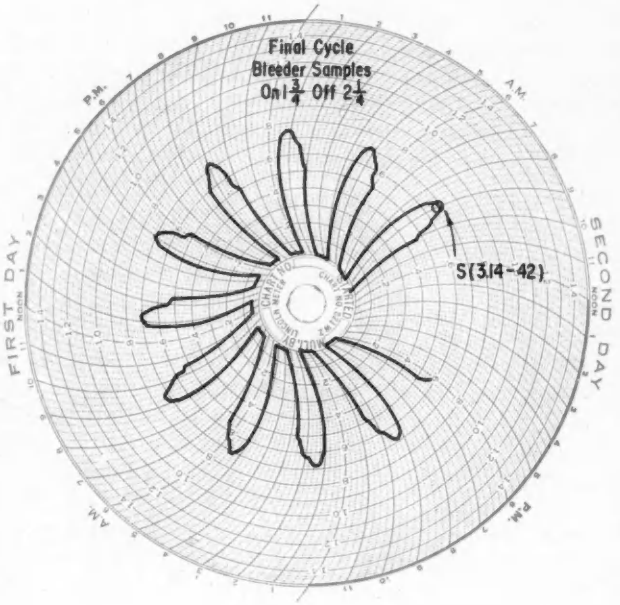


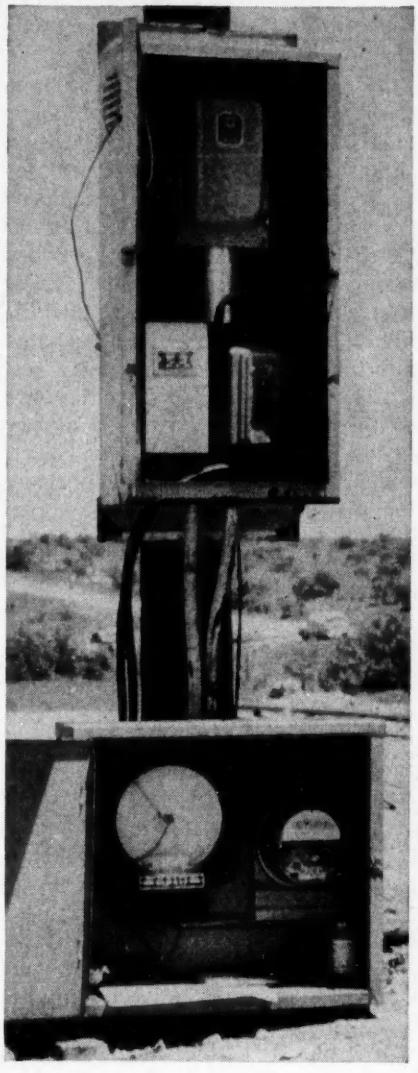
FIGURE 1—Effect on production rate by controlling pumping time with graphic watt meter.

A—Well No. 5, Chart No. 1: Original pumping cycle, on 21, off 3 hours; producing 5¼ barrels of oil and 15½ barrels of water per day; Peak production rate, 2.4 barrels fluid per hour, 36 percent oil; Minimum production rate, 0.9 barrels fluid per hour, 24 percent oil.



B—Well No. 5, Chart No. 7: Final pumping cycle, on 1¾, off 2¼ (total pumping time 10½ hours); Producing 5¼ barrels of oil and 15½ barrels of water per day; Peak production rate, 3.1 barrels fluid per hour, 42 percent oil; Minimum production rate, 0.9 barrels fluid per hour, 24 percent oil.

Motor control circuit (right) with graphic watt demand meter in lower portion of the picture. Meter should be attached immediately behind fuses in motor control box to record electrical demand of the motor. Demand recorded on chart is an indication if the pump is pumping to capacity. By adjustment of proper cycle, a pump can be operated at an efficient rate with reduction in power consumption and elimination of excessive movement of equipment.



Oil/Water Percentage Determination Chart

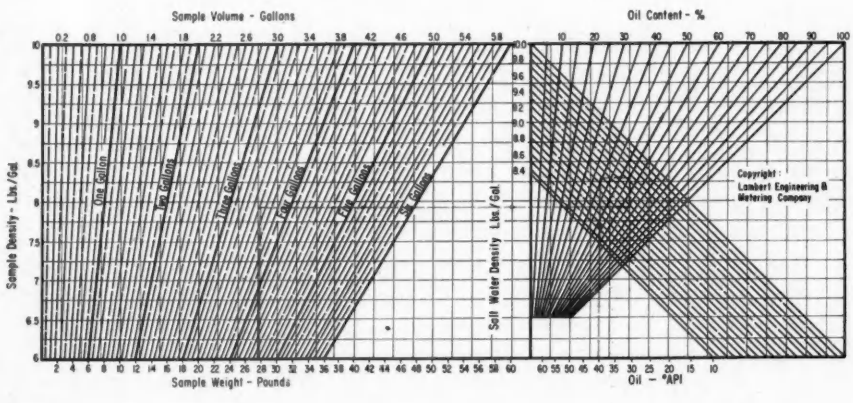


FIGURE 2 (below left)—Using the chart to determine oil/water percentage. Given: 40-degree API oil. Salt water weighing 9.2 pounds per gallon. Sample weight 27.8 pounds. Sample volume 3.5 gallons.

Procedure: Enter chart at 27.8 pounds weight. Follow vertical line to intersection with volume of 3.5 gallons. From that point, go across chart to intersection with salt water density of 9.2 and hold this point. Enter chart from lower right side indicating 40-degree API oil. Go up the chart to an intersection with 9.2 salt water density. From this point, go across horizontally until vertically above the point last established. This last intersection shows the percentage of oil, in this case 54 percent.

between samples, give the production per day of both oil and water.

By closely following this procedure at all wells pumping into a common tank battery, it has been possible to obtain better than 90 percent accuracy in calculating the total production. Eleven wells on a lease were tested and analyzed. Two charts depicting the different pumping cycles, from one of these wells are shown in Figure 1. The results of several samples taken are noted on these charts. The first number represents the barrels of fluid per hour being produced at the time the sample was taken while the second number represents the percentage of oil in the sample. The chart shown in Figure 1a depicts a typical demand curve of the original cycle. Samples were taken at several points on this cycle indicating production of 5¼ barrels of oil and 15½ barrels of water per day.

By adjusting the cycle to give a peak output from the pump at all times, a record as shown in Figure 1b resulted. Samples taken during these second cycles indicated no change in oil or total fluid production. However, this cycle change did give a 50 percent decrease in pumping time and a 40 percent decrease in electric power consumption. The total calculated production from all eleven wells was 38.7 barrels per day while the actual gaged production at the tank battery was 36.0 barrels; a difference of only 7.5 percent. Similarly, the production of eight wells on another lease was calculated to be 113.7 barrels of oil per day whereas the actual production was 108 barrels, a difference of 5.3 percent.

Note that the especially designed conversion chart shown in Figure 3 covers the complete degree—API and salt water density ranges. In order to simplify the use of this chart, other charts have been made to cover narrow ranges of degree—API oil which eliminates one step in the large chart and therefore makes the simpler charts more easily understood. However, charts can be obtained to cover all ranges of degree—API or small increments of degree—API.

Complications may arise from different type wells when using this method. For example, if there is a considerable leaking of gas in the fluid, care must be taken that foam has entirely settled prior to checking the volume. Also, the gas may create enough pressure to make the well appear to flow off during the test. This can be counteracted by measuring the pressure in the flow line against which the well is pumping and with an adjustable pressure release valve in the bleeder set slightly above the pressure encountered in the flow line. It is also important to obtain a new tare weight prior to taking each sample because there is an increasing amount of dirt and sediment on the outside of the sample container as it is used.

The equipment required to perform this test included a graphic watt demand meter, a sample can, a beam scales, and a volume measuring device. These are all small and can be carried around the lease in the pumper's truck. Only 10 or 15 minutes are required to obtain and analyze each sample. The entire test of a well's initial production and any cycle change requires between two and three man-hours and is easy to execute. There is a minimum waste of oil during the test since each sample usually contains only two to five gallons of fluid.

By incorporating the graphic watt demand meter into this test, it is possible to obtain a permanent graphic record of the electrical demand on the motor. It is possible to retest the well at a later date and compare the two charts for either similarity or change in demand requirements. Thus a change to a lower demand level would indicate a decreased volume being handled by the pump. The pumper could then adjust the cycle to raise up the demand level to that of the previous test. He could feel assured that the well was making just as much oil in a shorter period of pumping time because the pump would be operating nearer its rated capacity during the entire cycle.

The wattmeter chart and samples also give a good indication of the performance of a pumping unit. For example, any malfunctioning of pump or gas anchor, or the need of relocation of tubing or pump will be indicated from the samples and chart. The pumping cycle can be adjusted to make the pump operate at its highest efficiency during the entire cycle. Also the effect of resetting the stroke or strokes per minute to agree with the available flow of fluid into the pump at the bottom of the well can be evaluated. It is commonly known that a pump set at a certain stroke and speed will handle a definite volume of fluid at a rated efficiency. For example, a 1½ inch pump with a 28 inch stroke, 18 strokes per minute and 65 percent operating efficiency, should handle 3.6 barrels of fluid per hour. After a sample has been taken and the pumper determines the rate of production, he will know whether or not his pump is producing at its rated capacity. If not, indications are that the pumping time is too long, which is determined by the level of demand on the chart, or that the pump is not operating correctly. This could conceivably involve two possibilities; a worn ball-seat or plugged inlet to the pump. For example, one well recently showed a production rate of only 1½ barrels per day on test. When this test brought out the low production rate the operator pulled the pump and found the gas anchor plugged with paraffin. After correction the production rate was six barrels per day.

The other alternative for adjusting stroke or speed is prompted by an evenly producing well. If the unit continually puts out a given rate per hour and no more even after a cutback in pumping time, then the available oil flow into the well is only this rate per hour. By adjusting either the stroke or speed, or both, the operator can pump this rate, reducing power consumption and eliminating excessive movement of equipment.

In conclusion, the testing technique discussed actually provides three tests in one:

- An analysis of well's oil production per cycle and per day. It can be expected to be at least 90 percent accurate when carefully following this system.
- It gives an indication of the overall percent performance efficiency of the pumping system.
- It gives an indication of the operating equipment efficiency in the pumping system.

ACKNOWLEDGMENT

Based on a talk given by the author before the 29th Annual Conference, Petroleum Electric Power Association, Amarillo, Texas, June 5, 1957.

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[1] Graphic Wattmeters Used to Balance Pumping Cycle, Rex N. Brown, World Oil, January, 1955.

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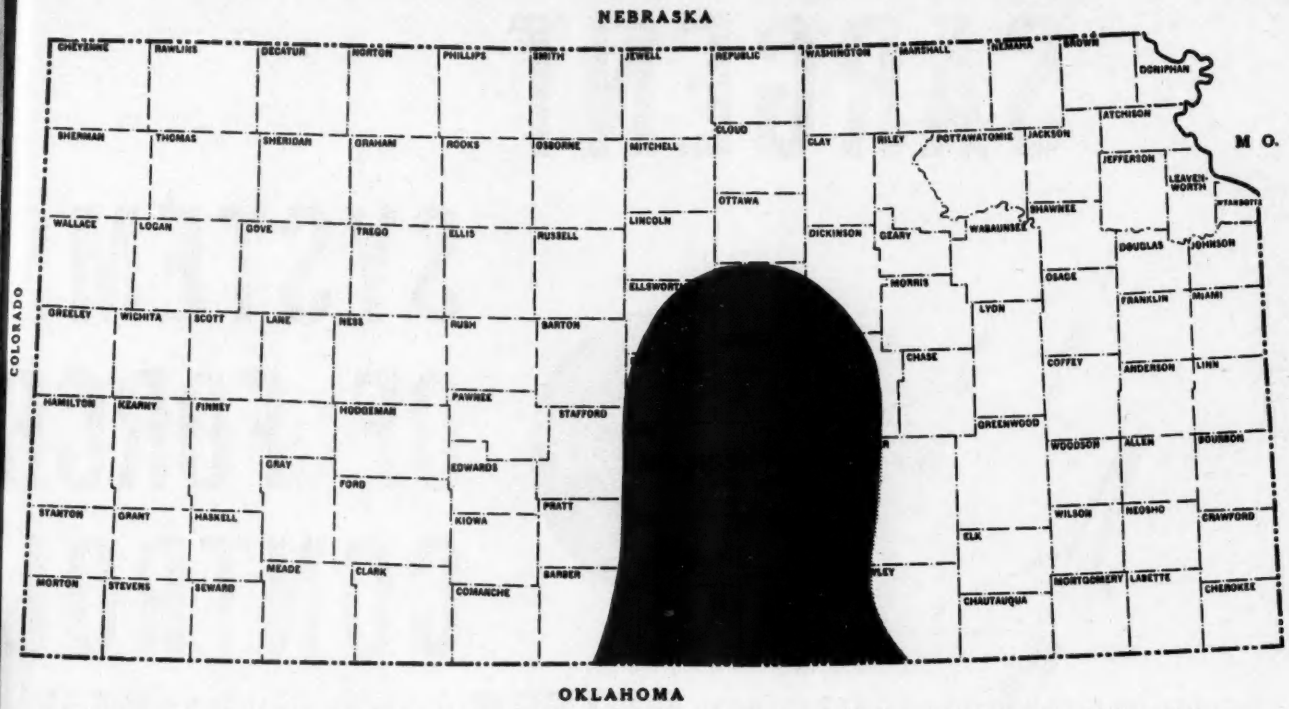

Stimulation treatments have resulted in increased production from wells producing in the Mississippi Chat formation of Central Kansas.

Stimulation of Mississippi Chat in Kansas

Fracturing and acidizing treatments on more than 1000 wells producing from Mississippi chat in Central Kansas have been studied. The result—a description of the applicable techniques that should produce maximum stimulation benefits.

By A. J. ETCHEN
Dowell Incorporated
McPherson, Kansas

MANY WELLS PRODUCING from the Mississippi Chat formations in Central Kansas have responded favorably to acidizing or fracturing treatments. The composition and characteristics of this formation show considerable variation from area to area in Kansas, and the stimulation techniques to be employed must be varied accordingly. Certain stimulation techniques and procedures have become established, based on familiarity with the characteristics of the Mississippi Chat from conducting acidizing or fracturing treatments of more than 1000 wells producing from this formation. This discussion of the major classifications of the Mississippi Chat formation and a description of the applicable techniques that should produce maximum stimulation benefits will be of value to many operators.

The Mississippi Chat produces from near Herington, in Dickinson County, Kansas, at depths slightly below 2000 feet, to Cheney, in Sedgewick County, Kansas, at depths of almost 4000 feet. This territory includes Dickinson, Marion, Saline, McPherson, Harvey, Sedgewick, Rice, Kingman and Reno counties.

For the purpose of this discussion, the Mississippi Chat has been divided into three major classifications:

Type No. 1: Insoluble chert, either white or buff in color. Wells producing from this type of formation are found mostly in western McPherson County, and in Reno and Rice counties.

Type No. 2: Chert, predominately, but containing some calcium carbonate or magnesium carbonate. This formation is found in Dickinson, Marion and McPherson counties. Sometimes it constitutes an upper pay, with Type No. 3 as a producing formation at greater depth.

Type No. 3: This formation is fairly soluble in acid, because it is composed of from 5 percent to 40 percent dolomite. Often this dolomite is lenticular, and, on the basis of the few cores available for study, the lens may be vertical or horizontal.

Acidizing. The effectiveness of acidizing has varied considerably between the three types of formation, as follows:

Type No. 1: This type does not respond to acid. It will accept acid, usually at pressures of less than 1000 pounds per square inch. However, no stimulation has been obtained except in a few cases of cleaning up mudded-off wells.

Type No. 2: Small gallonage acid

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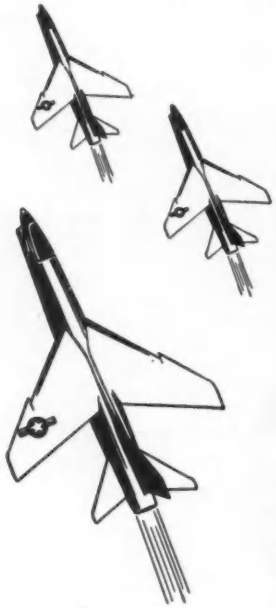

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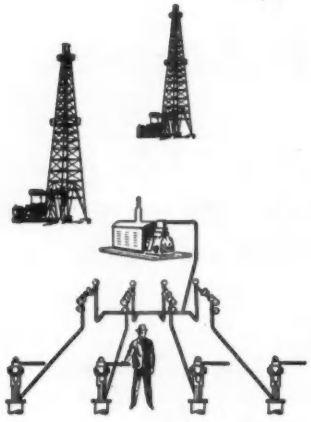

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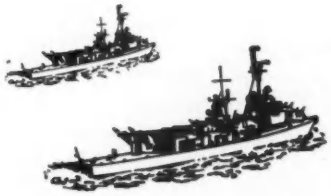
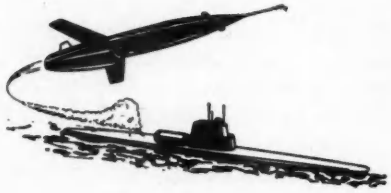


"GOOD WILL" is the disposition of the pleased customer to return to the place where he has been well treated.
– U.S. Supreme Court



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treatments have resulted in slight production increases from wells in this formation. Specifically, wells producing at a rate of approximately 1 barrel of oil per hour have been stimulated to about 2 boph, even though subsequent treatments employing larger gallonages failed. Results on less productive wells have been disappointing. Recovering acid from the formation required a long time, and production increases, if any, were small.

Old wells in this formation have been helped profitably by small gallonage acid treatments, usually employing 500 or 1000 gallons of 15 percent acid, containing detergents. The most successful method consists of, first, pumping the well down, then introducing acid down the casing annulus. After a one- or two-hour soaking period, the acid is displaced slowly, using salt water or fresh water.

An example of the results from this type treatment are four old wells, located in the Lost Springs pool. All four wells were treated during the same day, using 500 gallons of 15 percent acid containing detergents, in each well. The acid was pumped into the well bore and, after a soaking period, was displaced slowly into the formation. In this manner, monthly oil production of 750 barrels from this lease was increased to 2000 barrels. Two years later the lease was still making 1000 barrels of oil per month.

A survey of 300 similar wells treated using the procedure described indicated that, of the treatments performed, 60 to 65 percent were considered profitable to the operator. An additional 15 percent of the wells treated produced enough additional oil to pay for treatment, and the treatments possibly slowed the decline curve. The remainder of the treatments were regarded as failures on the basis of production stimulation, but many of these wells had been considered hopeless, and were treated as a last resort before abandonment.

Type No. 3: The response to acidizing of wells in this type of formation has been very good, as a rule, although the results have varied from pool to pool. The best results have been obtained when intensified acid was injected at low pressures, and the job conducted slowly. Excellent results were obtained using this treating technique in the Bartholomew pool near Cheney, Kansas. For these treatments, 1000 gallons of 15 percent intensified acid plus detergent were used. Individual well production increased from 1 or 2 BOPH, natural, to as high as 100 BOPH. Results from other fields in this formation, while not as sensational, were very good.

Although some wells producing from certain types of the Mississippi chat show better response to fracturing than to acidizing, production from wells throughout the area has been increased by stimulation treatments.

The use of slow treatments using low pressure is the result of field experience and is designed to minimize the possibility of injecting acid into non-productive zones. The effectiveness of decreasing the acid injection rate is illustrated by a wildcat well in Saline County, that tested 1 BOPH. This well was treated at a maximum pressure of 900 psi using 2000 gallons of 15 percent acid. Production increased to 30 BOPD. A second well was drilled and treated in the same manner, with almost identical results. A third well was drilled and came in natural for 1 BOPH. This well was treated slowly as recommended. One thousand gallons of intensified acid was injected at a maximum pressure of 250 psi. Production increased to about 400 BOPD, swabbing, after this treatment.

Other wells drilled nearby responded with excellent results. One of the wells had failed to respond to a 2000 gallon acid treatment at 900 psi. When re-treated at a maximum pressure of 150 psi with 1000 gallons of intensified acid behind 40 gallons of temporary plugging agent, an impressive production increase resulted. Before treatment the well tested 14 BOPD, increasing after treatment to over 200 BOPD.

Fracturing. Unlike acidizing, fracturing has been applied successfully to all three types of Mississippi Chat formation. Different fracturing techniques are required, however, for each of these types, as follows:

Type No. 1: Wells in the Bornholdt pool of western McPherson County were among the first Kansas wells fractured. One acid truck was used for mixing small batches of sand and crude oil. Although some production increases were obtained, the backwashing of the formation during the treatment, much as in acid treatments, may have been responsible.

At the present time, fracturing is an accepted completion practice in any wells in the Type 1 formation that require stimulation. Such treatments generally employ 3000 to 5000 gallons of refined oil or gelled lease oil, containing about two pounds of sand per gallon.

Type No. 2: The application of fracturing has revived much interest in the Mississippi Chat, particularly in the Lost Springs pool. Wells in

Maximum stimulation benefits from the fracturing treatment are obtained by close control and coordination of pump rates and injection pressures.

this area accept large quantities of sand. At the present time, 20,000 to 40,000 pounds of sand per treatment is used, at injection rates of from 15 to 20 barrels per minute. Often, and especially on old wells, 500 to 1000 gallons of acid-kerosine gel are injected into the formation before the breakdown with crude oil.

Initial fracturing treatments in this area, before the development of present fracturing techniques, were conducted as follows. Tubing and packer were run, then 1500 gallons of No. 6 fuel oil containing one pound sand per gallon, was pumped. Pressures of 4000 psi at injection rates of ½ bpm, were encountered. During the crude oil flush, following the fracturing materials, pressure would drop to less than 1000 psi, at injection rates of near 2 bpm. Production from these wells increased, although two wells became plugged with the heavy fuel oil. Production from one of these was restored by pumping in 500 gallons of kerosine and 500 gallons of acid.

Improved fracturing techniques currently applied to such wells employ less viscous fracturing fluids. The use of acid-kerosine gel not only avoids the plugging action of the fuel oil but results in dissolving soluble portions of the formation, further enlarging flow channels. Generally speaking, good results can be obtained by fracturing Type 2 wells.

Type No. 3: Because wells in this formation respond to acid, fracturing treatments have not been used extensively.

The Lively or Galva pool of McPherson County is an exception. In this pool, the formation is highly fractured and contains some shale breaks. Acidizing results have been good when the formation accepted acid at 100 psi or less. However, when the dolomite section was tight and higher pressures were required, the results have not been good. In some cases, production was decreased. Evidently, the acid was entering a shale streak.

Fracturing wells in this pool has resulted in satisfactory production stimulation. At the present time, 100 wells have been fractured, using 1000 gallons of acid-kerosine gel, containing one pound sand per gallon. In conducting these treatments, one diesel pumper was employed to inject the fracturing materials at a rate of 5 to 7 bpm, at a pressure of 1500 to 2000 psi. Treatments have all been successful, with the exception of two or three mechanical failures.

Small volumes of sand have been used because of a tendency to screen out during the latter part of the treatment. Wells in this formation, particularly the new wells, have not accepted large quantities of sand. Perhaps the presence of shale is responsible. Larger amounts of sand were employed on fracturing treatments of three old wells, which previously had been fractured. One well took 10,000 pounds of sand satisfactorily. The next well screened out after approximately 8000 pounds of sand had entered the formation. When fracturing the third well, the amount of sand was reduced to 8000 pounds and it was all injected satisfactorily.

Generally speaking, any Mississippi Chat well, not subject to heavy or sustained water drive, is considered a good prospect for fracture treatment. Even the presence of water is not always serious. In the Galva pool of McPherson County, wells making 50 percent or more water, natural, have been fractured. Often, the water ratio decreased substantially after treatment. In very few cases did it increase.

A high fill-up of oil, without aid of gas drive, is usually indicative of heavy sustained water drive. Under such conditions, an acid treatment, using relatively small amounts of acid, is preferable to fracturing, provided the solubility warrants and a stimulation treatment is considered necessary.

Summary. Fracturing has been employed successfully to stimulate production from wells completed in all three major types of the Mississippi Chat formation. However, if the formation is sufficiently soluble, an acid treatment may be preferable. Although some wells in all three types of formation have responded to acidizing, acid stimulation is usually limited to Types No. 2 and No. 3. In Type No. 2 formation, old wells have shown the best response. Small gallonage acid treatments have proven more successful than those employing larger gallonages. Type No. 3 responds better to acid than do the other type formations. Best results are obtained by slow treating at low pressures, and by using intensified acid. Present day stimulation techniques, which have been developed by field experience, have resulted in substantial production increases from wells in the Mississippi Chat formation. **—The End**

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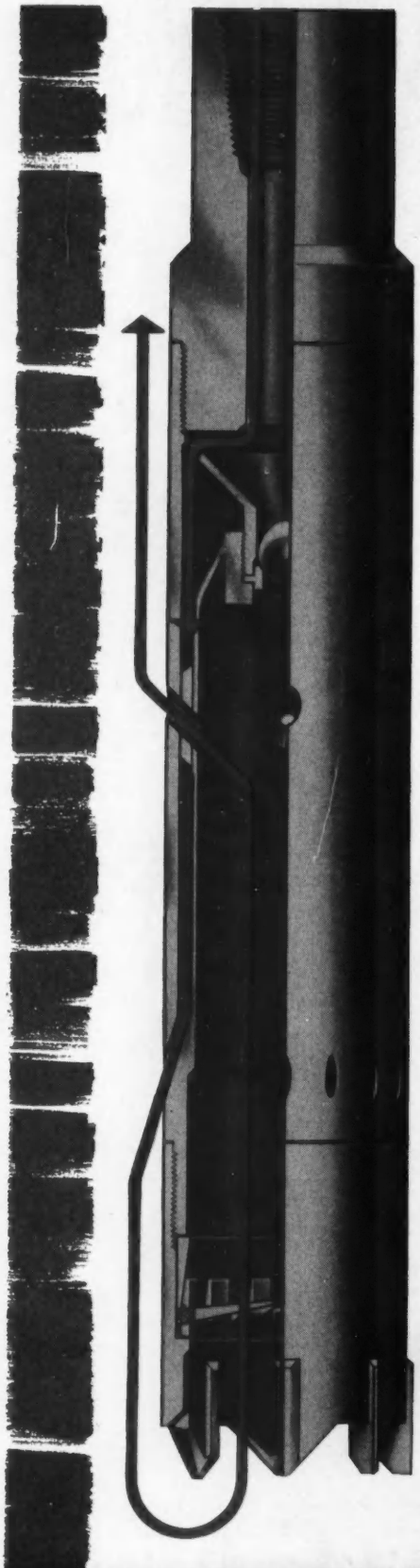

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South Zone Bright Spot in Mexico

Drilling, exploration, production are expanding throughout entire area at an increasing rate

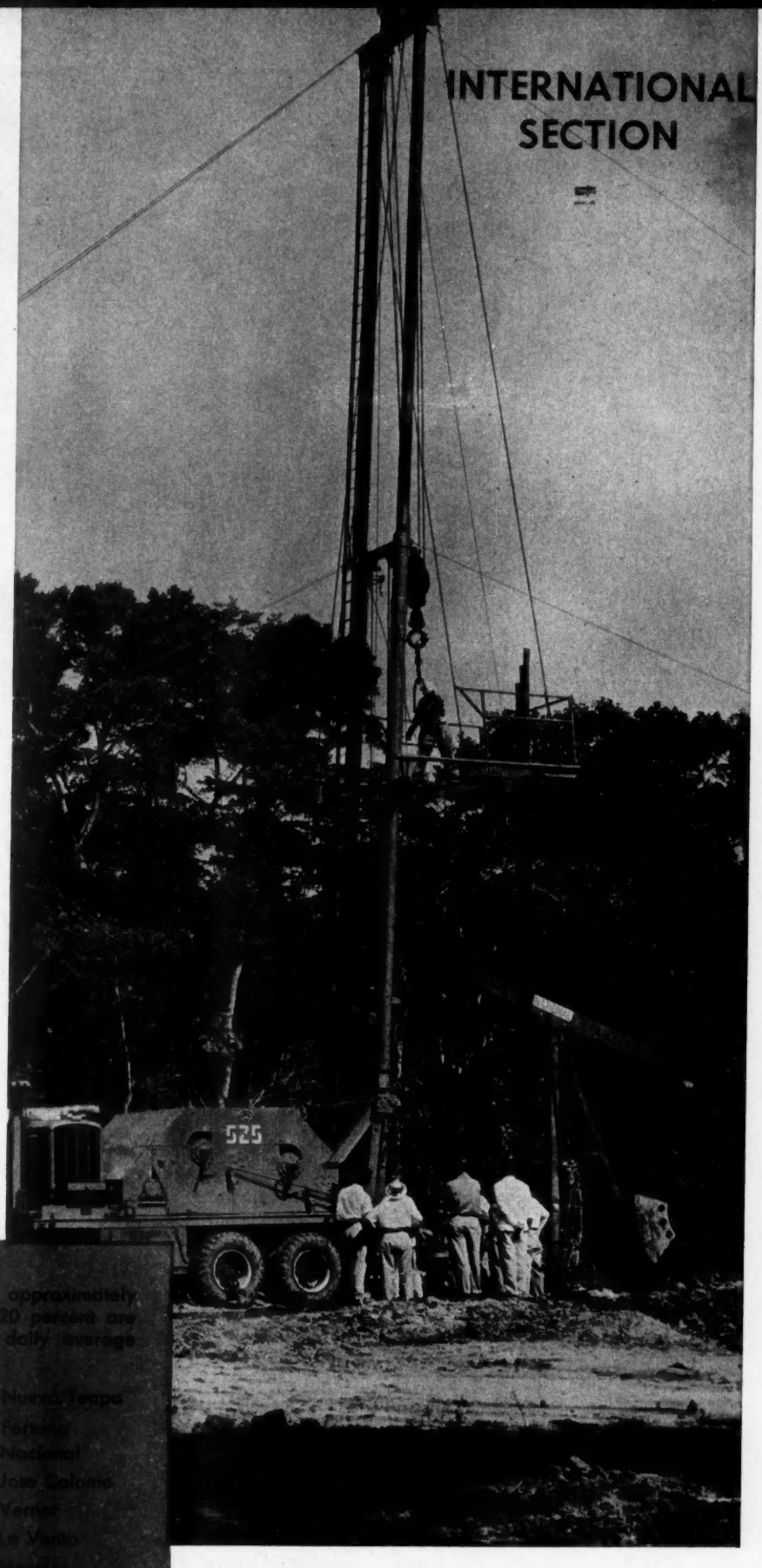
By LOUIS M. GASCHE
Fred E. Cooper, Incorporated
Tulsa

AN ACTIVE DRILLING program, continued success in the discovery of new reserves and expansion of refining facilities mark the operations of Petroleos Mexicanos in Mexico's so-called Southern Zone, which centers around the Isthmus of Tehuantepec.

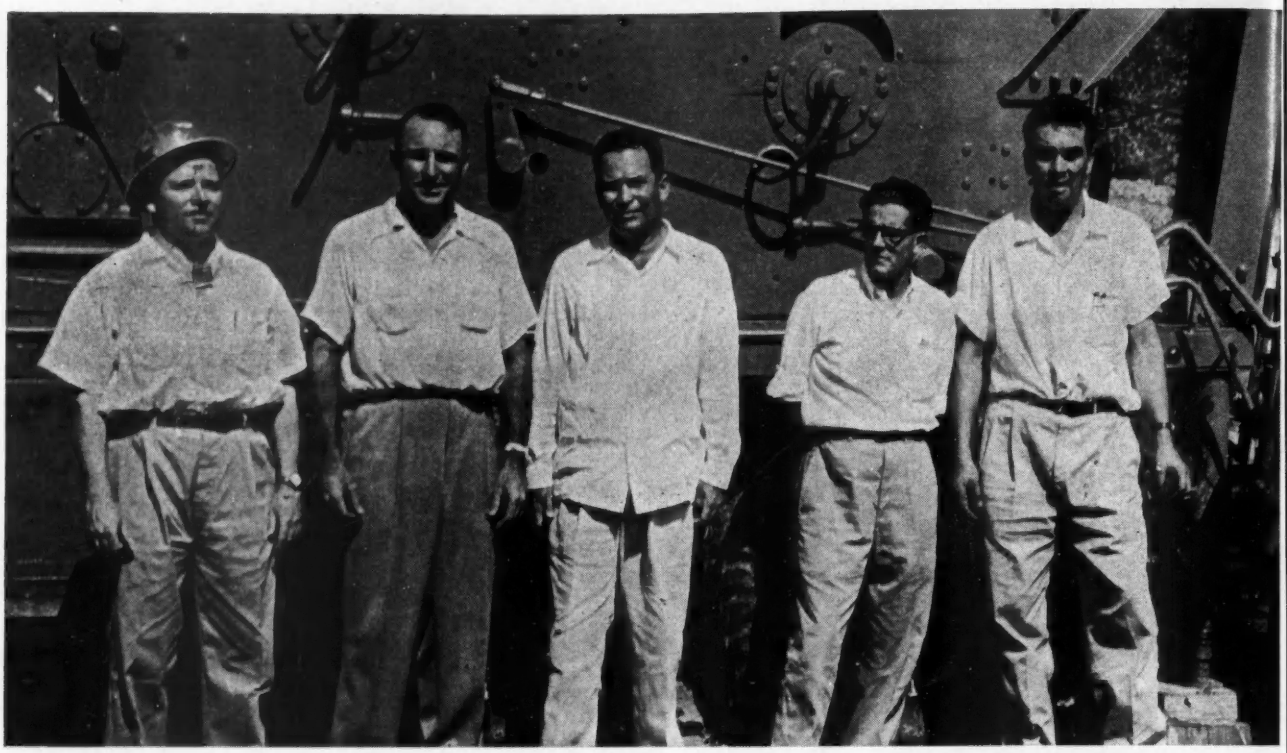
Currently, there are 21 producing fields in the Southern Zone:

Several of these fields are relatively new, and the Southern Zone has a total of approximately 500 producing oil wells.

An extensive exploration program is under way, principally in Southern



This workover operation is being conducted at an old producing well in the Southern Zone in the Isthmus of Tehuantepec area. On an average, 20 percent of the 500-odd wells in the Southern Zone are serviced monthly.



With the exception of the author, second from left, these men are responsible for Petroleos Mexicanos operations in the Southern Zone. Left to right are Ing. Enrique Huerta Arguelles, production chief, Southern Zone; Gasche; Ing. Jose J. Nettel Flores, general manager, Southern Zone; Ing. Roberto Rodriguez Montes, field superintendent; and Ing. Mauro Santamaria E., chief of production in the Agua Dulce district.

Veracruz State and Tabasco State. Limited work also is being done in the neighboring states of Chiapas and Campeche.

The search for new fields is being conducted by the most modern means available. A wide range of special equipment is necessary to conduct the geophysical program. An extensive Marine department, including speed boats, houseboats, swamp buggies and other special purpose equipment is combined with aircraft and helicopters to negotiate the difficult terrain. The dense jungle growth in some areas and the almost endless swamp lands in other areas are the two major obstacles to the development of their petroleum reserves.

Petroleos Mexicanos builds and maintains many of the roads in this area. The construction of several new principal roads through the area is under way. Exploratory drilling is confined in some areas to those locations which are accessible by means of barge. It is not uncommon to see a rotary drilling rig located a few hundred feet from the bank of a navigable river with the crews living on a large barge equipped with living quarters. In many areas, water transportation is the only means available for moving the heavy rotary drilling rigs onto location.

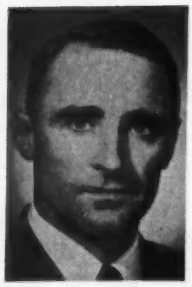
An extensive program of electrification is being carried out in the Southern Zone, with approximately 40 percent of the producing wells currently being pumped by electrical power. Additional power supply facilities are being constructed. One of the most modern plants currently under development is to be constructed at Nanchital which will contain two gas turbine powered generating units.

The wells vary in depth from as shallow as 500 feet to as deep as 9000 feet. Moloacan Ixhuatlan and Nuevo Teapa are among the shallow fields. Medium depth fields in the 5000 foot to 7000 foot range include El Plan and Los Soldados. One of the deepest fields is the recently developed Jose Colomo area. Well head gas pressures ranging from 2500 to 3000 psi are not uncommon in this new field. Open hole potential gas flow on some of these wells has ranged as high as one hundred million cubic meters* per day, but the wells actually are being produced at seven to fifteen million cubic meters per day.

An absorption plant is being built

Continued on Page 158

About the Author



LOUIS M. GASCHE, executive vice president of Fred E. Cooper, Inc., is a native of Hartford, Kansas, and a graduate of Kansas State College, with a degree in mechanical engineering. He joined the company upon graduating in 1938, and was elected vice president in 1953. Gasche has worked in most of the oil producing areas of the U. S. in Mexico. During World War II, he served in the army as an engineer in the Ordnance Research and Development Center at Aberdeen Proving Grounds, Md., and elsewhere.

Interest Grows in Oil's Legal Problems Abroad

Here is a checklist that can save time and money—and even disappointment—to the growing number of domestic operators who are considering conducting operations outside the U. S.

By BURNEY BRALY
Continental Oil Company
Houston

THE NUMBER of American oil operators entering international operations is increasing more rapidly every year, and there is an ample background of experience from which they may benefit if they will take the trouble to study it in advance. Though there is no way to assure a clear path in dealing with foreign governments, there are many basic considerations that should be heeded to avoid future difficulties. Canada probably is the only country outside the U. S. with similar oil leases and recognized procedures basically like those in the U. S.

Here are the factors which should be considered:

1. Political stability of a foreign country and its record for keeping its promises.

Big political changes, often totally unexpected, are taking place in many countries abroad. Generally, countries that have resisted leftist tendencies have kept the promises of former regimes as well as they have kept their own. This is often a function of legal, cultural, and at times, religious heritage, but private property rights can never be expected to survive complete socialization of a country.

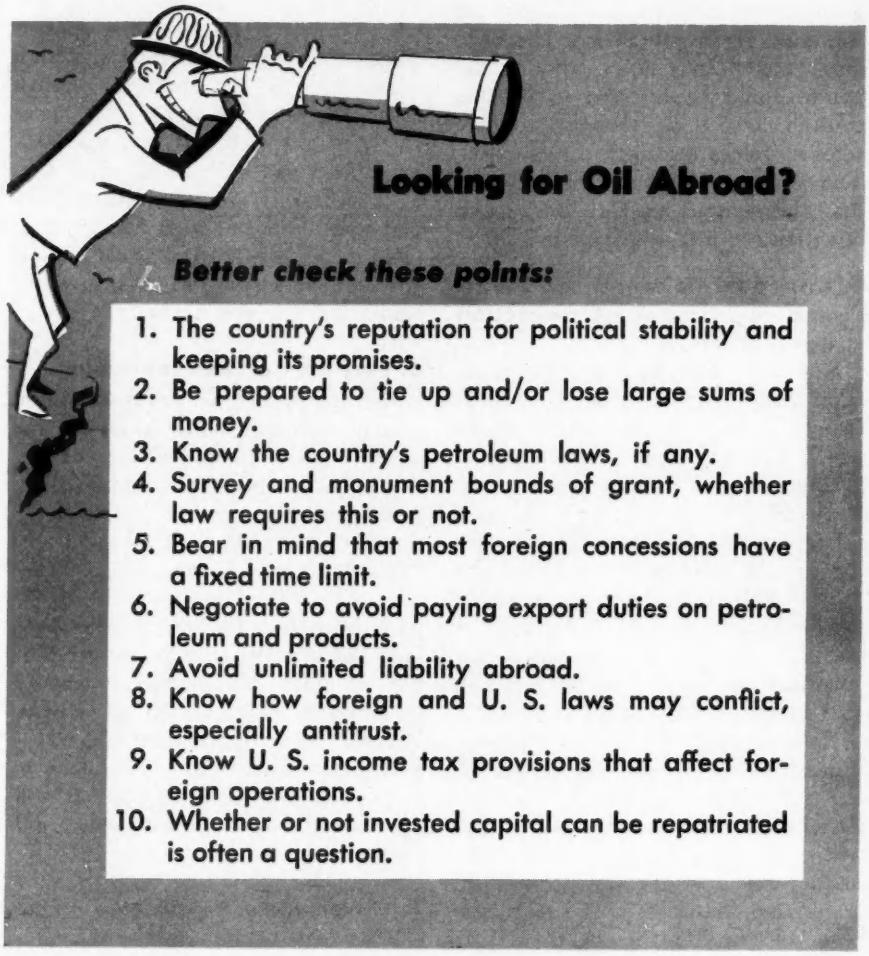
Since the Mexican expropriation in 1938, threats of nationalization of petroleum have been used to force oil companies into 50-50 profits sharing, and this has become a strong precedent everywhere, regardless of how profit sharing came to be in the countries where it has occurred.

Political stability, and whether you can reasonably expect any country to adhere to the agreements it makes with you before you commence looking for oil there, are the most important factors you must weigh before going in, spending your money, and taking your chances.

2. Eligibility of applicants for concessions and equality of treatment.

It is necessary to determine whether an American oil man entering a foreign venture, thus becoming an "alien," will be welcome and will be afforded equal treatment with indigenous, and other "alien," competitors. Generally Americans should not expect unbiased treatment unless the nationals of the country they enter are afforded equal access to similar business ventures in the United States. And some "friendly" countries pay only lip service to the "open door" policy, while grossly discriminating against Americans in favor of nationals of their own or other countries, without any existent statutory exclusion of foreigners.

In a colonial territory, the mother country may favor its own citizens. In countries recently emerged from a colonial status, there may be strong feeling against all foreigners, regardless of their legal status. Crowned


Looking for Oil Abroad?
Better check these points:
1. The country's reputation for political stability and keeping its promises.
2. Be prepared to tie up and/or lose large sums of money.
3. Know the country's petroleum laws, if any.
4. Survey and monument bounds of grant, whether law requires this or not.
5. Bear in mind that most foreign concessions have a fixed time limit.
6. Negotiate to avoid paying export duties on petroleum and products.
7. Avoid unlimited liability abroad.
8. Know how foreign and U. S. laws may conflict, especially antitrust.
9. Know U. S. income tax provisions that affect foreign operations.
10. Whether or not invested capital can be repatriated is often a question.

rulers of some European countries have participated in oil operations both at home and abroad and have often been suspected of exerting diplomatic and economic pressures toward the objective of receiving special favors. Whether the U. S. oil man going abroad likes it or not, he may expect to find foreign governments or agencies thereof among his competitors, unless the laws of the country specifically prohibit companies connected with foreign governments from operating there.

Like U. S. oil and gas laws, foreign oil laws are essential real estate laws, and the individual country's attitude toward the status of the land will govern in large part the nature of its oil laws.

It is sometimes essential that a company prove to a foreign government that it is financially capable of the undertaking it proposes.

3. Ownership of petroleum deposits as between governments and private landowners.

Most foreign governments assert title to all petroleum deposits. There is no known case where a foreign government's general claim of title to the minerals in patented or alienated lands has been challenged, but the point should be referred to reliable counsel in the particular country since no relevant universal rule exists. The experience of the writer indicates that the general level of ability and integrity of foreign lawyers is high.

4. Concession areas and terms and conditions of concession agreements.

Some countries have specific, thorough and detailed petroleum codes. Others have obsolete mining codes which are applied to concession agreements only vaguely, sometimes with difficulty, and often with considerable latitude of interpretation on the part of the government and the courts. Still other nations have no petroleum laws at all. The degree to which the terms of concessions are governed by bargaining alone varies greatly depending on the country.

In some countries, specific limitation as to size of grant, etc., vary from one part of the country to another. Generally, large areas may be granted where the geology is little known, smaller ones where data are more ample and the element of risk is less. Undeveloped countries opening their lands to oil exploration solve the problem of to whom to grant concessions in different ways. Some countries grant rights for the entire country to one operator, without regard to date of request. Other countries have laws to govern the manner in which overlapping applications be resolved, either by drawing lots, requiring joint operation of overlap areas, auctioning off the area to the highest bidder, or by granting it to the company which in the opinion of the government is in the best position to develop it.

Often, in the last case, the decision is final and there is no right of appeal for operators considering themselves aggrieved by the decision.

Some foreign statutes authorize concessions which provide for two or three operational stages, such as an exploration license, followed by a prospecting license and finally by a lease. Or all stages may be combined by a single concession contract, avoiding need for future negotiations and additional contracts.

5. Defining the concession area.

Concession contracts should clearly describe the land intended to be covered, particularly at the development stage. However, in many countries, particularly in desert and swamp areas, the land has never been accurately surveyed and monumented. Whether it is legally required or not, an operator should establish corners and lines of the area to be included, monument his results, and obtain government approval of this work, before starting any drilling.

6. Purposes of the concession.

The purpose of the grant should be clearly stated, leaving no room for interpretation. In addition to having the right to explore for and produce petroleum, the grantee should have the right to sell in the field or at any other point of delivery and to transport within the country—also to export through or by any facilities provided or selected by him. Any intention to refine or manufacture should be provided for in the agreement. Ways of obtaining refining and transporation rights vary considerably from one country to another, as will cash considerations, rents, work, and expenditure obligations.

7. Government royalties.

This may be determined by competitive bidding. Foreign statutory government royalties vary upward from 12½ percent; and 50-50 profit sharing provisions, whether statutory or merely customary, are common.

8. Term of the grant.

In the U. S., leases usually endure "so long as oil or gas is produced." Virtually all foreign concessions run for fixed terms, e.g., 40 or 50 years, with the right to renew for one or more shorter periods. This practice, though undesirable, seems firmly established. Such a fixed term is undesirable because it discourages good oil field practices, behooving the operator to get all the oil he can while he can in his own interest, regardless of the public interest.

Orderly development, entailing outlay of vast sums of money over many years, may result, particularly in the case of a field found late in the concession's tenure, in the operator's losing his holdings at the termination date before he has recovered his investment. And the concession, now of tremendous value, may bring a huge price from another company for a new concession. In time, we hope that many foreign countries may be induced to continue concessions so long as oil or gas is produced therefrom, but this is only something to hope for, not to depend on.

9. Relinquishment and assignment of the concession.

The concessionaire should be privileged to quit whenever it becomes apparent to him that the project is not likely to be profitable. Specific language should provide for this in the concession. Also, the right to assign the grant in whole or in part is desirable. Generally, foreign governments make this aspect subject to their approval to avoid speculation and to exclude personae non grata from the country. However, it is desirable for the grantee to be allowed to transfer his rights to a parent corporation or subsidiary without government approval, and many petroleum codes grant this right.

10. Taxes and duties exemptions.

To invite capital and encourage new industries, some countries allow relief from taxes and export duties by law. Such relief can sometimes be had for the asking when all concession terms are open to negotiation. However, necessity to share profits with

the government may reduce the value of such special relief.

Foreign income and profits taxes may, at the election of the U. S. taxpayer, be deducted from income or taken as a credit against his tax. Thus, exemption from foreign taxes can sometimes work to one's disadvantage, where what was tax is converted to non-tax obligation (e.g., rental, royalty), to the foreign government.

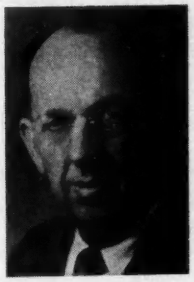
Wherever a concessionaire can negotiate to avoid paying export duties on petroleum and products, he should do so.

11. Guaranteeing performance. A bond or "banker's guaranty" usually is required under any foreign concession, either fixed by law or negotiation. An indemnification agreement, supported by a deposit of cash or other security, may be required by the guarantor of the concessionaire. If the guaranty must be executed by a foreign bank, the guarantor may demand that it be assured by a U. S. bank. To avoid risking loss and tieup of cash in a foreign bank, it may help a concessionaire to arrange a letter of credit from a U. S. bank to give the foreign bank the necessary assurance, to be drawn upon by the foreign bank pursuant to demands under the performance bond.

Care should be taken in drafting a performance bond to include provisions for sufficient notice of claims asserted thereunder to afford the concessionaire a fair opportunity to question or pay such claims before the government resorts to the bond.

12. Avoiding unlimited liability abroad. For tax and control purposes, a corporation, when expanding into new areas, may find it advisable to carry on without using subsidiary firms. But the tax and organizational advantages may not offset the risks of unlimited liability attending a large American corporation domiciling itself in a foreign country. Ruinous foreign legal judgments can be avoided by a U. S. corporation through operating a subsidiary licensed to transact business in the foreign country with minimum capital to enable it to be so licensed. Working capital in the form of loans can be advanced by the parent firm as needs arise.

About the Author



BURNEY BRALY, who retired as associate general counsel for Continental Oil Company on October 1, joined the firm in 1926 as an attorney in the Legal department at Fort Worth, Texas. Two years later he was named chief attorney, and in 1949 became associate general counsel and moved to Ponca City, Okla. A year and a half later he was moved to Houston, where he retired.

Braly was born in Minden, Texas, and was graduated from Cumberland University in 1913 with an LL.B. degree.

13. Anti-trust problems at home. In planning foreign operations, the impact of our own anti-trust and monopoly laws must not be overlooked. Not all problems arising from foreign interests are due to foreign laws. A corporation domiciled or organized in the U. S. always is within reach of our courts, and, in the case of United States v. Aluminum Company of America, the Court of Appeals found that the conduct complained of was intended to affect domestic imports and to restrain trade.

American oil men may find conflicts between the laws of the U. S. and a foreign country and may incur risks if they simply follow the tack of "When in Rome, do as the Romans do." Our anti-trust agencies say in effect, "If you cannot do business in Rome without thereby restricting domestic or foreign trade of the U. S., then do no business in Rome unless you are prepared to pay the penalty."

Some few foreign countries have anti-trust laws that are enforced only indifferently, and emphasize protection of their own industries against outside competition far above any insistence on competition and fair trade. Any hope that they will enact anti-trust laws similar to our own is a fond one indeed.

Statements in a few opinions of judges in anti-trust cases have created interest in the question of whether a corporation may safely undertake producing or manufacturing operations abroad through subsidiaries or affiliated corporations. Problems related to doing business through subsidiaries in foreign trade have been interestingly reviewed in a report of the American Bar Association entitled "Anti-trust Problems in International Trade." Jointly-owned subsidiaries for foreign oil operations apparently are not illegal per se, but since there is little necessity for creating them, utilization of them might well be avoided.

A better alternative might be to develop and operate a foreign concession under an operating agreement to which several interested companies might be parties. Any contract covering joint producing or processing operations should contain no agreement which might in any way restrict the domestic or foreign commerce of the U. S. Each participant might agree to take in kind, and dispose of, his share of the products; such a clause also shows the contract does not create a taxable entity.

14. U. S. income tax problems relating to foreign operations. Where foreign laws permit, a domestic subsidiary to an established corporation should be organized to operate a foreign concession, and all possible U. S. tax advantages should be preserved to the parent firm. And, since operation could be a total failure, the parent firm should be in a position to charge off its investment in stock of, as well as cash advances to, the subsidiary, as an ordinary loss, not a capital loss.

Stock of a domestic subsidiary corporation will not be treated as a capital asset of the parent if at least 95 percent of each class of stock of the subsidiary is owned directly by the parent firm, and more than 90 percent of the subsidiary's total receipts have been from sources other than royalties, rents, dividends, interest, annuities, or gains from sales or exchange of stocks and securities, according to the Internal Revenue Codes. Subject to various regulations and qualifications, the parent corporation can deduct, as bad debt losses, the (adjusted) amounts of advances

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were designed with the elimination of high lifting costs as an objective — the results — a small bore pump so trouble free in its operation that it has actually prolonged the economic life of stripper wells.

The Sand Hog is purposely built with small fluid passages so the velocity of the discharged fluid remains high, preventing any settling of entrained sand. A skirt diverts the discharge of the fluid to a point below the bottom of the traveling barrel—continuously washing the hold-down and flushing the annulus between the pump and the tubing free of sand. The cleanest oil that will separate out of this produced fluid floats up between the pull tube and barrel, and on each suction stroke supplies a film of oil to lubricate and reduce friction between the barrel and plunger.

If you are blue over high lifting costs on low volume wells, ask your Oilmaster Representative to deliver a Sand Hog before your next pulling job and prepare for a change of mood when you compare its trouble-free performance with that of any pump you have previously run.

oilmaster PUMPS FOREMOST IN THE INDUSTRY

FLUID PACKED PUMP CO.

Main Office and Plant, Los Nietos, California

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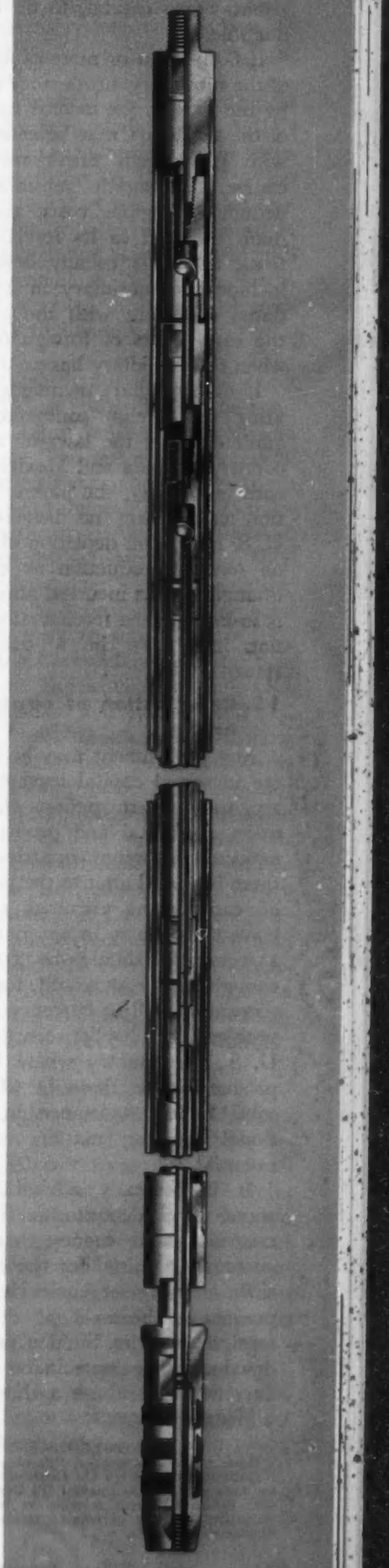


to a subsidiary which become worthless, regardless of the percentage of stock owned by the parent. Such advances must represent loans, not contributions to capital, to be thus deductible.

If 80 percent or more of all classes of the subsidiary firm's stock is owned by the parent, the income tax return of the subsidiary may be consolidated with the parent firm's return. Of course, a domestic subsidiary may deduct intangible costs and other items incurred in its foreign operations, but it is usually desirable to include the subsidiary in a consolidated statement with the parent in the early years of foreign operation when the subsidiary has no income.

If the subsidiary owning and operating the foreign concession is organized under the laws of a foreign country (Canada and Mexico in some cases excepted), the parent corporation can obtain no benefits under U. S. laws from depletion allowances on foreign production or expensing intangible costs incurred abroad. This is so because the foreign subsidiary is not includable in a consolidated return.

15. Repatriation of capital and profits.

Any government may be loathe to see imported capital leave the country, and legal restrictions on expatriation of capital and profits may be expected in foreign countries. Usually there is a legal limit to the percentage of capital and earnings that may leave the country in any one year. If a company should be fortunate enough to produce oil for export, there may well be currency exchange problems to solve between that of the U. S., the country where the oil is produced, and those in which it is sold. Expert assistance in international banking matters would be essential.

It is generally advisable not to transfer to depositories in foreign countries more money than will be currently required for the enterprise, since often emergencies hamper or prevent withdrawal of deposits in foreign countries. Sudden, unexpected devaluation or depreciation of foreign currencies often are a threat to deposits there.

ACKNOWLEDGMENT

From an address entitled "Problems Related to Negotiations of Foreign Oil Concessions" delivered by Burney Braly, Continental Oil Company, Houston, before a recent meeting in New York of American Institute of Mining, Metallurgical and Petroleum Engineers.

Mexico's South Zone

Continued from Page 152

at Colomo which, when completed, will have a processing capacity of 300 Mcf daily from which 16,000 barrels of liquids, including gasoline, will result per day. This plant is being built at a cost of $10 million. A 22-inch pipe line is being constructed from this area to Coatzacoalcos and Minatitlan where the residue gas can be used for refinery and sulfur plant fuel.

Oil production in the Southern Zone is all from sand formations. Paraffin formation and corrosion are two of the major problems in producing. Both mechanical paraffin scrapers installed on the sucker rod string and chemicals are used to combat the paraffin problem. In some extreme cases, steam is injected into the annulus to expedite paraffin removal. Some tests are being conducted on electrolytic control of paraffin. Electrolytic corrosion is experienced in some areas, but is being controlled to the extent that it does not present any serious production problems.

The majority of the wells are completed by setting pipe below the formation, then perforating. Jet type perforating reportedly gives the best results. There are some dual completions. While considerable quantities of salt water are produced in some areas, its disposal does not present a problem. In practically all instances, it may be turned loose on the surface without creating any contamination problem.

To obtain maximum production from the wells in the Southern Zone requires an extensive workover and servicing program. On an average, 20 percent of the total producing wells are serviced each month. This servicing can vary from a short rod job to a major workover. A year ago, the daily average production in the Southern Zone was 22,000 barrels. It is now 28,500 barrels per day, with a considerable portion of the increase coming from the older wells as a result of the intensive workover and re-conditioning program.

A modern 50,000 barrel per day refinery is being completed at Minatitlan. The catalytic cracking unit already is in operation. This installation will provide a source for high octane gasoline stocks. The products from this refinery will be distributed on both coasts. Water transportation is available into the Bay of Campeche and the Gulf of Mexico. Products for the West Coast will be carried by pipe line to Salina Cruz, thence by boat to West Coast points.

The operation in the Southern Zone is self-sufficient. They build and maintain their own road system, operate their own telephone system, operate their own electrical generating plants and distribution systems, maintain their own Marine department which includes a wide range of sizes and types of water-borne craft. They have their own air transport system, and the outstanding safety record which this service has established is the result of the combined utilization of well maintained aircraft operated by highly skilled personnel. The terrain over which they fly is quite adverse. The landing fields usually are narrowly bulldozed out in a jungle clearing.

Maintenance equipment procedures and programs are thorough and effective, despite adverse conditions which prevail in some areas of the Southern Zone. Well equipped field maintenance shops have been established. Down time is held to a minimum on production equipment. A controlled inventory of spare parts also contributes to keeping the equipment in operating condition.

The year around temperatures in most of this area ranges from 60 degrees to 100 degrees. The high humidity that exists in many areas does make the higher temperatures rather uncomfortable, particularly to one accustomed to the higher altitudes.

Approximately 6000 employes are engaged in the Southern Zone operations of Petroleos Mexicanos. The average work week is 44 hours. Medical benefits, including care for members of the workers' families are included. Commissaries are maintained where employes are given the benefit of reduced prices. A house rental allowance is also provided, unless employes live in company housing.

The maintenance of modern hospitals and clinic facilities which are available to all of the employes and their families, combined with an extensive mosquito control program, is largely responsible for the excellent health which the average Petroleos employe enjoys. **—The End**

a WORLD of OIL

By **DON KLIEWER,** World Oil Staff

ALGERIA: SNP (A) Ourgla 1, extension to Hassi-Messaoud oil field, may have found over 700 feet of oil pay from about 10,725 feet to 11,450 feet, reports indicate. However, reservoir characteristics of Permo-Triassic pay sand are poor—porosity varies from 7 to 12 percent, permeabilities in one to eight millidarcys range in Ourgla 1. At Talemzane, second test was a dry hole, indicating a small oil field, very likely non-commercial. . . In the Fort Flatters area, Tiguentourine North appeared to be a new field discovery, separate from the oil field being developed at Tiguentourine. A flow of 30 barrels of oil per hour was reported at Tiguentourine North with a deeper pay yielding gas at the rate of 1.68 Mmcf of wet gas per day. A third pay, still deeper, yielded almost 7 Mmcf of wet gas daily.

ARGENTINA: The government has authorized its oil agency Yacimientos Fiscales Petroliferos to sign a contract with a U. S.-Argentine syndicate for construction of two pipe lines and two topping plants, valued at a minimum of $115 million. Fish Engineering Corporation and an affiliate, other North American capital, and TIPSA, an Argentine company, compose the syndicate. Included in the project are a 1000-mile, 24-inch gas pipe line from Campo Duran field to Buenos Aires, a 12-inch crude oil line from Campo Duran to San Lorenzo, and field installations at Campo Duran. . . A proposed 12¼-inch pipe line from Mendoza to San Lorenzo has been shelved for the time being. . . The Aramburu Government impaired its already shaky chances for attracting foreign capital into the country to revitalize oil and other industries when it ordered Compania Argentina de Electricidad, a firm backed by European capital, to cease operations on the alleged ground that CADE was improperly granted permission to operate in Argentina 19 years ago.

AUSTRALIA: West Australia Petroleum Pty Ltd (WAPET) has abandoned Rough Range 10 at 3740 feet. This test, only 750 feet northeast of Rough Range 1A, Australia's only indicated oil well, recovered cores from 3658 feet to 3664 feet with oil shows. The interval 3651-3664 feet, on two tests, yielded salt water cut with oil and gas. Section thus cored and tested was the Bridrong Sandstone.

CANADA: Santiago Petroleum Corporation, a member of the Buckley interests, has acquired 12½ percent interest in 1,163,554 acres in the Northwest Territories of Canada, immediately north of and adjacent to the northern border of British Columbia. Exploration work has already begun.

DHOFAR: With only two wells completed on the proven Marmul structure, Cities Service Oil Company is confident it has found a major field, with at least a billion-barrel reserve likely.

ECUADOR: Santiago Petroleum Corporation (Buckley interests) has acquired 1.5 million acres in Ecuador from Manabi Exploration Company.

GUATEMALA: Petrolera San Miguel is a new firm of the Buckley group incorporated in Panama to explore for oil in Guatemala. Applications are pending on 565,000 acres.

HONDURAS: Barnwell Offshore, Inc., of Shreveport, La., is reported to have signed a contract with Compania Petrolero Hondurena for two deep wells in Honduras. First test, slated for 15,000 feet, is to be spudded in Aug. 1, 1958. One test is to be offshore and the other onshore.

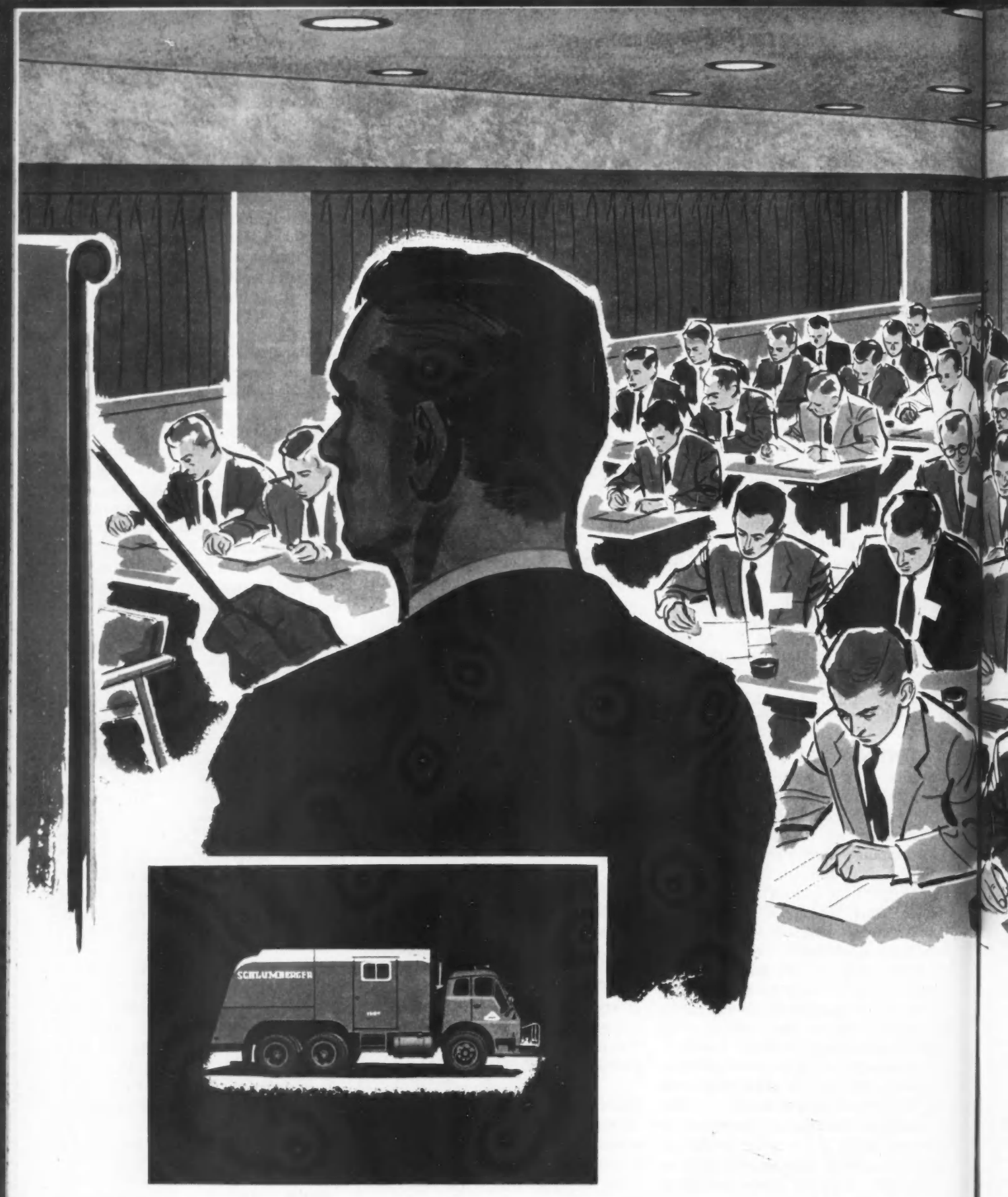
INDONESIA: The government is reported considering the adoption of new legislation to encourage private foreign capital into oil and other industries. Competition between countries for foreign capital has spurred Indonesian fears that it may be left out if necessary legislation is delayed too long.

ITALY: Previous drilling records in Italy have been shattered by AGIP's Piadena 1, near Cremona in the western part of the Po Valley. The exploratory test had reached a depth of 17,224 feet by late July, the limit of the rig, which was being replaced with another capable of 20,000 feet. Deepest well reported in Italy as of mid-1956 was 10,800 feet.

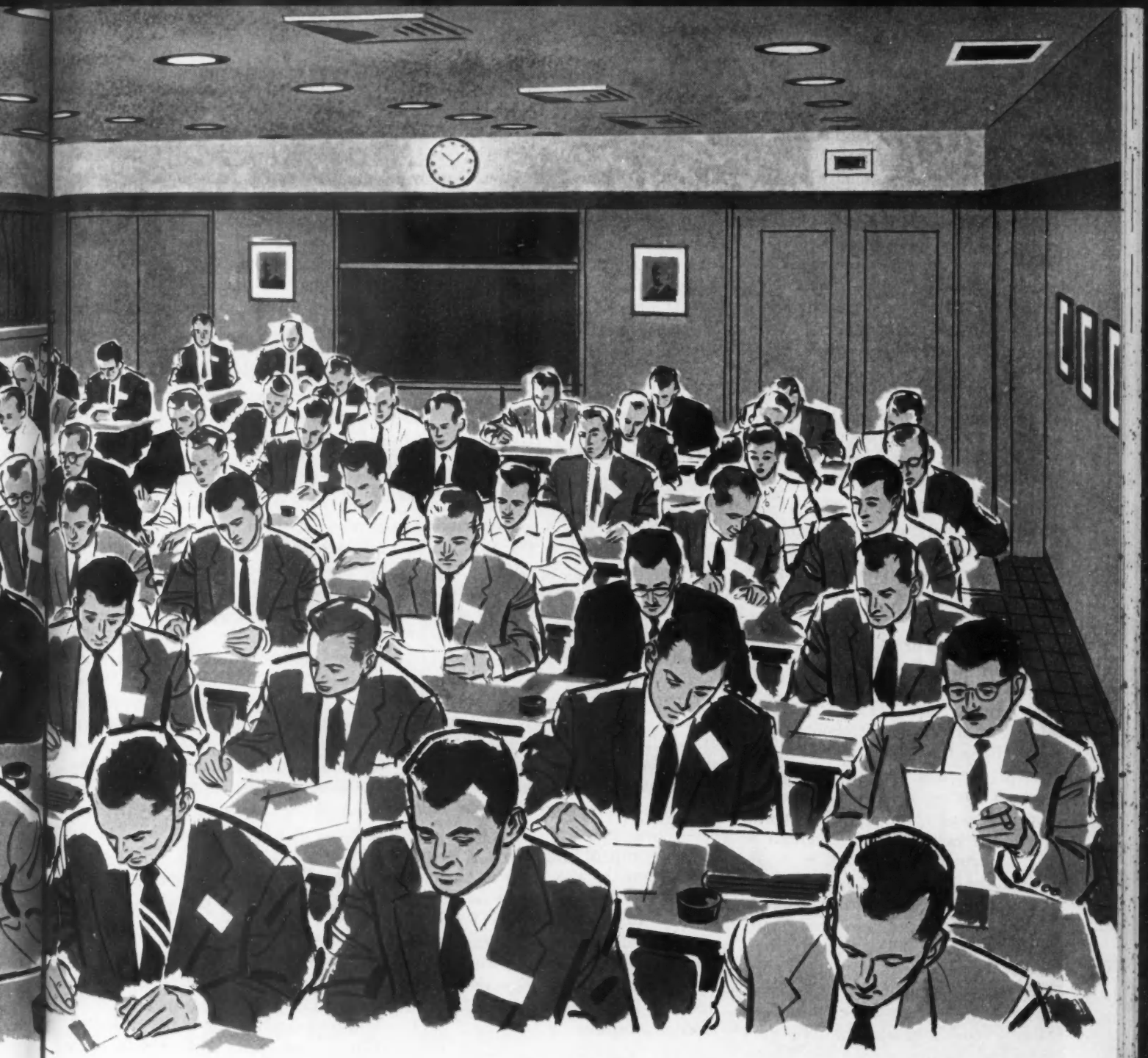
LIBYA. Esso Standard (Libya) Inc.'s Haghe 1, first test drilled by the company in Libya, encountered oil and gas shows. The test is on concession No. 1, in the Fezzan, bordering eastern Algeria, with the well located 75 miles south-southeast of Algeria's Edjele oil field. The test is being drilled to 6000 feet or basement if at a shallower depth. Oil and gas shows in thin sand stringers, varying from 580 to 1000 feet in the Carboniferous section productive at Edjele, were found. One test yielded oil and gas cut mud . . . In late July, the test was drilling ahead at 2200 feet . . . The government is seeking better terms on new concession applications than specified by Libyan oil law, particularly early drilling commitments. No warning was given prior to cancellation of two Libyan-American Oil Company permits for alleged non-compliance with terms. Major discovery at Hassi-Messaoud in Algeria has caused Libyan Government to push permit-holding companies to accelerate exploration.

PERU: El Oriente Petroleum Company completed its second Contamana concession oil well on July 14, located 1640 feet from the March 10 discovery in Eastern Peru 200 miles north of Ganzo Azul field. Production is estimated at 500 barrels per day at the extension well from the same pay as the discovery. Three more wells are to be drilled in the field, according to "Noticias."

SICILY: Rapid development of AGIP's important new Gela field on Sicily's south coast was taking place, with four wells being drilled on 1300-meter (about 4300 feet) spacing stepping out from the discovery well, com-



"The more extensive a man's knowledge of what has been done, the greater will be his power of knowing what to do."—Disraeli



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pleted in April. At the end of July, Gela 2 was drilling at 9400 feet. Well 3 had reached 10,600 feet and was being readied for production at that depth. Gela 4 had reached 5640 feet, and 5 was drilling at 3560 feet. Gela 1 continued to produce at the rate of 1250 barrels daily on pump, with the crude being shipped to the Rasiom refinery at Augusta on the east coast . . . Exploration boom was continuing with July, 1957, discovery of the Rosolini field by AGIP, located 20 miles east-southeast of Ragusa field. Fifty feet of oil-saturated, porous Triassic dolomite was found below 7000 feet. Production tests indicated the discovery well would yield about 500 barrels per day of 19 gravity crude oil.

TAIWAN: Nationalist China will build six 36,000 dwt supertankers and has acquired marine turbines for the purpose . . . The ships are being built at Keelung.

VENEZUELA: The Atlantic Refining Company and the Pancoastal Petroleum Company completed Caro 2 in the Aguasay area of the state of Monagas, at a depth of about 13,665 feet. The well has been tested at 1554 barrels per day of 32 gravity oil through a one-quarter inch choke. An upper zone at about 12,600 feet also was tested earlier with a potential of 862 barrels daily through a 5/16-inch choke . . . Atlantic and Pancoastal, which jointly hold approximately 13,500 acres in this area, completed Caro 1 on March 14 . . . Construction was to begin shortly on a 5½ mile, $98 million high-level railway and highway bridge across the Maracaibo Strait. The Venezuelan firm Precomprimido, together with Julius Berger of West Germany, are the constructors. Tolls charged on all passengers and freight are expected to pay out costs in seven years . . . Terminales Maracaibo is a new $25 million company formed to provide integrated services for oil companies operating in Lake Maracaibo in Venezuela. Compania Shell de Venezuela has assigned 260 acres of land for industrial subdivisions, in return for which Shell receives 187,500 fully-paid shares in the new company. Terminales Maracaibo will provide warehouses, yards, shops for repair and overhaul of equipment, and other facilities for use of oil and service companies active in the Lake.

Italian Parliament Is Considering New Law Covering Offshore Waters

The Italian Parliament is considering a new petroleum law to apply to offshore waters, which are specifically excluded insofar as the application of the recently established petroleum code is concerned.

Several oil companies have expressed interest in Italy's offshore oil prospects, particularly those in the Adriatic coastal area. Preliminary drafts of the proposed offshore oil legislation have been satisfactory enough to draw several reported preliminary applications. Though basic principles of the newly-established petroleum law applying to onshore operations are incorporated in the proposed offshore bill, the latter is much more liberal.

Single exploration permits may cover as much as 240,000 acres, twice that allowed onshore. An individual firm may acquire up to 960,000 acres in such permits, compared with a limit of 720,000 acres onshore. Exploration permits have a six-year term, twice that onshore, and two extensions of three years each would be allowed, making a 12-year tenure possible for an exploration permit.

If oil is found, a development concession as large as 21,600 acres may be granted, as compared with 7200 for an onshore discovery. Term of the concession is 30 years (20 on land) with one ten-year extension allowed. Lease rentals on concession areas are one-third those onshore, and lower royalties also are required by the proposed offshore legislation than required by the onshore petroleum code.

Seismic Study Is Made Off New Caledonia

Societe de Recherches et D'Exploration des Petroles en Nouvelle Caledonie (SREP-NC) has completed an offshore seismic program in Noumea Lagoon, near the south end of the island. Geological and geophysical studies were being continued in 1957 in the two concession areas held by the company since April, 1953. The two concession areas are Koumac, along the northwest shore, and Gouaro, in the central part of the island. These areas total 164,791 acres. In 1956, the company completed 163 miles of marine seismic profiles, as compared with 650 miles in 1955.

Ownership of SREP-NC is vested 65 percent in the French Government Bureau de Recherche de Petrole (BRP), 15 percent in the Territory of New Caledonia, 10 percent in Compagnie Financiere de Recherches Petrolieres (COFIREP), and the remaining 10 percent in other miscellaneous interests.

Canadian Homestead Acquires Pennant Firm

Canadian Homestead Oils Ltd., has acquired Pennant Drilling Ltd. Canadian Homestead exchanged 850,000 shares of its common stock for Pennant's complete capital stock. Of this total number of capital stock, Crescent Corp., principal stockholder in Pennant, received 642,625 shares, or approximately 24 percent of the 2.7 million shares outstanding.

Pennant will be operated as a separate division of Canadian Homestead with no changes in personnel or policies. Clinton Wright will continue to direct all contract operations.

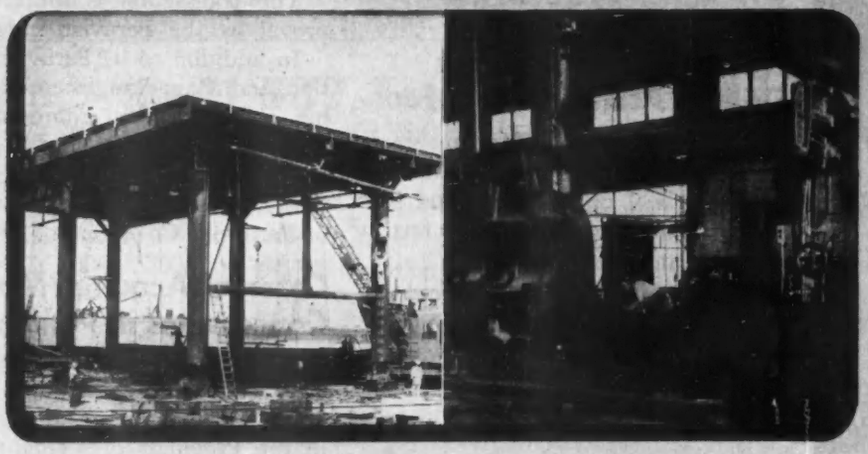
Swiss Firm Reportedly Seeking Nepal Permits

A Swiss firm, identity of which has not been disclosed, is reported in authoritative circles to have offered to prospect for oil in Nepal, a little kingdom sandwiched in between Red China and India. There has been some "nibbling" of Nepal by Red China, and there are friendly treaties between India and Nepal.

This Swiss offer now is under consideration of Nepal's government. Indications are, ultimately, that the oil project in Nepal will be a joint Indo-Nepalese venture, which would require considerable capital. Some foreign experts are reported to have expressed the opinion that oil prospecting in Nepal would be such a colossal venture that it would be doubtful if any single Swiss firm could undertake the entire financial obligation. A group of U. N. experts currently are surveying the mineral resources of Nepal.

For Tidelands Oil . . .

Peak Capacity, Nearby



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A map illustrates the fact . . . that in the fan-shaped riches of the Tidelands, there is one centrally-located point for construction and repair. That point is Avondale, with four major divisions compactly grouped in the New Orleans area. Moreover, Avondale has the facilities—the capacities—the special production tools required by offshore operations. For a small job—quick repair of a piece of drilling equipment—there is Avondale's enlarged Oil Field Machine Shop. For the design and construction of an elevated deck drilling barge—a big job in every sense of the word—there are Avondale's vast facilities at the River Plant. Yes, when you want the best and you want it fast, your nearest and most complete source is Avondale . . .

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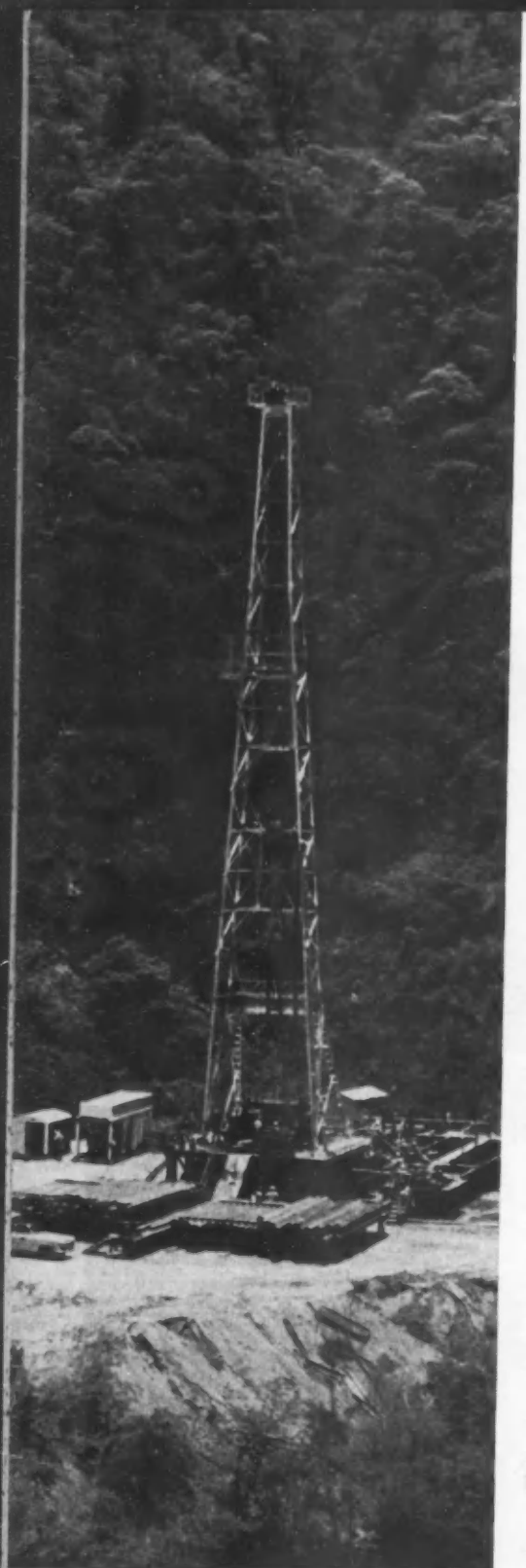


Isolated Rig

International Petroleum, Inc., is centering its Colombian exploratory drilling operations in the almost impenetrable jungle areas which are being opened up with the completion of Colombia's Magdalena River railroad. This International Petroleum drilling rig is located in the wild mountain areas near Girardot. Throughout Colombia about 12 million acres are under concession or drilling as the nation pushes to open new fields for increased crude production. Colombia, in 1956, produced about 44.7 million barrels, including natural gasoline, but its potential is pegged at a considerably higher figure.

Photo: Hamilton Wright.

International Petroleum Plans to Buy Half Interest in Peruvian Concession

International Petroleum Co., Ltd., a Standard Oil Company (New Jersey) affiliate, plans to buy half interest in a 138,000-acre Peruvian concession held by Lobitos Oilfields, Ltd. Under terms of the transaction, International Petroleum will invest at least $40 million in development of the Peruvian area by the end of 1961. International Petroleum already has a joint operating agreement with Lobitos on a part of the concession.

Eight million dollars of the purchase price will be used for development of the Peruvian area, Lobitos reported, and the remaining $10 million will go into the capital program of Lobitos, a British firm.

Lobitos directors said International Petroleum is scheduled to furnish financing for the Peruvian operation until the area becomes self supporting, explaining that Lobitos does not have sufficient funds to develop the area to meet local demand as well as to furnish oil for export to the English refinery—the more profitable phase of the business.

The transaction is subject to approval by the Peruvian government.

In addition to its Peruvian concession and Canadian interests, Lobitos has a 34.4 percent share in Anglo-Ecuadorian Oilfields, Ltd.

International Petroleum has extensive holdings and operates refineries in Peru and Colombia.

New Jamaican Wildcat Drilling Ahead at 535 Feet

Pan Jamaican Oil Company spudded in Pan Jamaican-Base Metals Negril 1 well on June 10, and was currently drilling ahead at 535 feet in a lime formation.

The well is located approximately five miles southwest of the Base Metals Negril Well 1, which was the first well ever drilled on the Island of Jamaica.

Khursaniyah Reserves May Exceed Billion Barrels

Khursaniyah 3, located three miles south-southeast of last year's major discovery at Khursaniyah 1, was being completed as an extension well, though it ran somewhat lower structurally than anticipated. Reserves of the new field were believed to exceed one billion barrels.

At Damman field, a deep test was being completed at about 10,200 feet as a high-pressure gas well in Permian beds.

Interest in pre-Jurassic possibilities of Saudi Arabia is increasing. Aramco may drill a wildcat about 70 miles west of Ghawar field for possible Paleozoic horizons.

Drilling of the offshore prospect at Manifa in the Persian Gulf, may be postponed. Aramco's drilling barge, the Queen Mary, was drilling Safaniya 25 in early July and locations through Safaniya 32 have been planned.

Aramco will retain four active rigs during 1957 in Saudi Arabia and expected to complete about 25 wells.

Cataract Acquires More Concessions in Panama

Cataract Mining Corporation of New York has acquired an additional 3 million acres of oil and gas leases in the Provinces of Veraguas, Bocas del Toro and Chiriqui in the Republic of Panama.

This acquisition makes Cataract the largest holder of oil and gas concessions in the republic. Cataract previously had acquired concessions in the Provinces of Darien and Chiriqui covering in excess of 2 million acres.

Pemex Plans Rapid Drilling in New Oil Field

Discovery of a new field, La Tinta, in Guerrero, Tamaulipas, close to the U. S. border has been reported by Petroleos Mexicanos, government-owned oil company. Strike of light oil was made unexpectedly at 970 feet, and the well caught fire. Extensive development is planned because of central location of field for the Northern Zone and because shallow depth permits rapid development.

Meanwhile, completion of a 350 mile pipe line between Tampico on the Gulf Coast and Monterrey, Mexico's industrial capital of the north, has been reported. Pipe line together with storage capacity for 9 million gallons represents an investment of $10 million.

Socony Mobil Orders 5 More Supertankers

Socony Mobil Oil Company has signed a contract for the building of five 48,600-ton supertankers at a total cost of more than $45 million.

The contract, between Mobil Tankships, a wholly-owned subsidiary, and Eriksbergs Mekaniska Verkstads Aktiebolag of Gothenburg, Sweden, calls for deliveries between 1960 and 1963.

This brings to 16 the number of new tankers now being built or on order for the Socony Mobil group of companies. They represent an investment in excess of $140 million and a combined tonnage of some 650,000 deadweight.

Rumania, France Extend Trade Pact; French Favor Iron Curtain Purchases

The Dec. 24, 1954, Rumanian-French trade agreement, valid for the period of three years, has been extended for three more years. The annual French contracts are to total 745,300 barrels of diesel fuel, 968,890 barrels of gasoline, and 372,650 barrels of fuel oil.

French business circles have said that owing to the precarious French foreign currency situation, buying behind the Iron Curtain is more advantageous than buying from Western firms. France, however, expressed doubts as to whether it will be able to sell 745,300 barrels of diesel fuel on the domestic market.

Meanwhile, the interrupted delivery of crude to Rumanian refineries—caused by production and transport difficulties—has resulted in insufficient refinery capacity utilization, according to charges printed in the Communist Bucharest daily *Scinteia*. Oil delivered from the fields is not free from salt and other impurities. Twelve percent of the crude charged at the No. 1 refinery of Oloesti during 1956 contained 17 percent more impurities than allowable.

Rumanian oil may not be exported to Great Britain, since Rumania has not yet offered any settlement of claims of British companies against their 1948 nationalized holdings in Rumania. An agreement was made with France to the effect that France receives a set annual fee through petroleum products delivery, thus enabling the government to compensate French claimants. Great Britain has said that no Rumanian oil will be imported to the island until the Rumanian government decrees a similar agreement as granted to France.

Texaco Drills 11,537-Foot Well in Wild Peru Area With a Shallow-Depth Rig

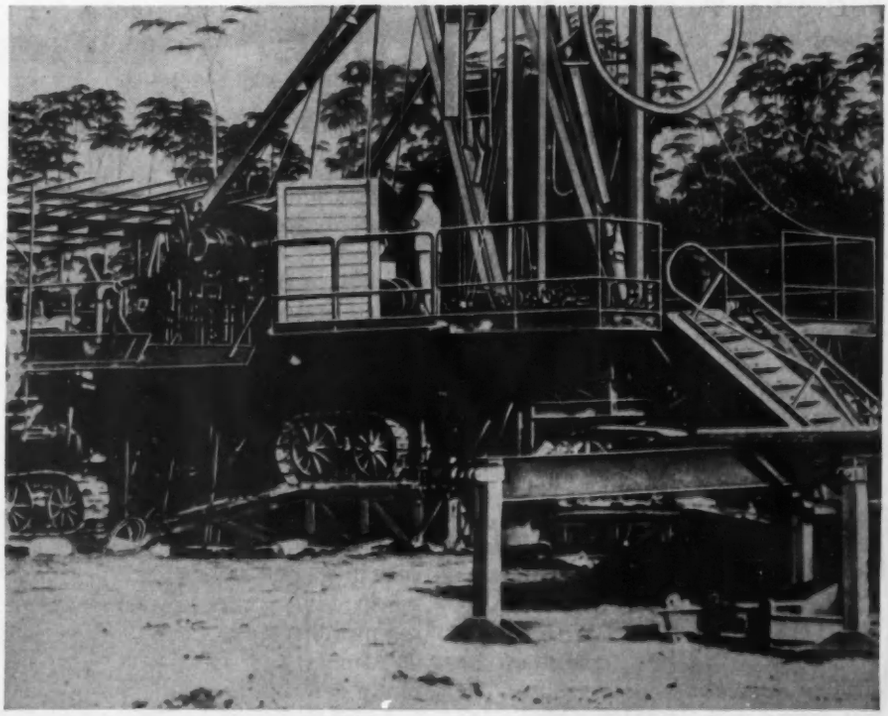
Using a drilling rig which under normal conditions would be considered for the 3000-5500-foot depth range, The Texas Company recently drilled an exploratory well in Peru to the depth of 11,537 feet.

The drilling location was in an almost inaccessible area at the eastern foothills of the Peruvian Andes, known as La Zona del Oriente. Because the drilling unit could not be transported to location across the Andes from the nearer west coast, it was necessary to deliver the rig to the mouth of the Amazon River on the east coast of Brazil. The rig then was transferred to a converted LST on which it was carried up the entire length of the Amazon River and part of the Rio Maranon into the interior of Peru, a trip of approximately 3000 miles, to within a distance of 250 miles of the Peruvian west coast.

Trailer-mounted, using tracklaying suspensions instead of wheels, the rig used a special drive unit powered by five engines. Drill tubing of 3½-inch diameter by 10.2 pounds per foot was used as drill pipe. Drilling required the use of 168 6¾-inch bits, two 9⅝-inch bits, and one 15-inch bit, as well as 16 core heads.

A 15-inch hole was drilled for the first 22 feet, 9⅝ inch to 1576 feet, and 6¾ inch to the bottom. Casing was 13⅜ inch for the first 22 feet, and 7⅝ inch to 1576 feet, with an open hole to the bottom. It had been intended to use a 5-inch oil string if production was found, but the hole proved dry. The main purpose of this location was, however, one of subsurface exploration.

Because the drilling location was in extremely swampy country, matting was laid to support the weight as the rig was rolled from the LST to the well site.



This trailer-mounted rig of The Texas Company drilled an exploratory well 11,537 feet in an almost inaccessible section of Peru. Note the use of tracklaying suspensions instead of wheels under the trailer.

What's Happening

AMONG WORLD OIL MEN

Harry L. Conner

George D. Comnas

GEORGE D. COMNAS and HARRY L. CONNER have been elected vice presidents of Esso Export Corporation. Comnas heads the newly-formed Crude and Sales department. Conner continues as comptroller of the company.

•

DR. ENVER NECDET EGERAN has been appointed assistant to the manager of Mobil Exploration Mediterranean, Inc., Socony Mobil Oil Company's Turkish producing affiliate. Former vice president of the Petroleum Administration of the Turkish government, Dr. Egeran is a native of Cyprus and was educated in Cypriot, Turkish and French schools.

•

RAIMUNDO J. GALLETTI has been appointed chief of the Commission of the Argentine Government Oil Fields in the U. S., New York, succeeding ROBERTO M. GIANNATTASIO, who has returned to Argentina to continue in the executive management of Argentine Government Oil Fields in Buenos Aires.

•

Two Houston men who have been associated with the Houston Oil Field Material Company, Inc. have assumed positions with Petrobras in Brazil. Petrobras is the petroleum branch of the Brazilian government.

They are WELDON C. CLAMPITTE and CHARLES F. RIKER.

Clampitte will be a consultant on drilling practices with Petrobras. He has served with HOMCO in the Directional Drilling department for many years and in many areas—including south Texas, Houston and Edmonton, Canada.

Riker who will be material engineer in Brazil, has served with HOMCO in its Machinery department. He will assist Petrobras in setting up its drilling rig and other machinery schedules.

•

MILO M. BRISCO and HENRY F. STEVENSON have been elected to the board of directors of International Petroleum Company, Limited. Brisco presently is International's executive representative in Colombia. Before being named to the board, Stevenson was an assistant general manager of Imperial's Marketing department.

•

ELEANOR C. DICKSON has been elected secretary of Standard - Vacuum Oil Company, the first woman to be elected to this office. Miss Dickson has been with Stanvac since 1935, and was promoted from the post of assistant secretary of the company.

Eleanor C. Dickson

•

T. MUIR WARDEN, O.B.E. and B.A.Sc., and D. D. IRWIN, Ph.B. and E.M. were elected new directors of Western Decalta Petroleum, Limited, Calgary, Canada. They were elected pursuant to the offer made by Centramic, Ltd. (a wholly-owned subsidiary of Central Mining and Investment Corp.) and by Selco Holdings Ltd. (a subsidiary of Selection Trust Limited of London) to invest $6,150,000 in Western Decalta.

Warden is a Canadian mining engineer who has had extensive experience in copper, asbestos and gold mining in various parts of the world. He is a member of the Canadian Institute of Mining and Metallurgy and currently is residing in London.

Irwin, former vice president of transportation and supply for The Pure Oil Company, is a member of The American Institute of Mining and Metallurgical Engineers and of The Institution of Mining and Metallurgy of South Africa. Irwin is a consultant residing in Winnetka, Ill.

•

EARL S. NEAL has been named deputy representative on Middle East matters for Standard Oil Company (New Jersey) in London, resigning his former directorship in Imperial Oil Limited to accept the new post. Neal, a mining engineering graduate of the University of California, has served previously as chief geologist for Standard of Venezuela (now Creole Petroleum Corporation) and later as head of the Producing Economics section of Jersey Standard.

•

RICHARD STEINHORST, JR., formerly field superintendent of the Colorado-Nebraska fields of The British-American Oil Producing Company, has been transferred by this company to the newly-established field office in Lafayette, La., to assume the position of field superintendent. This office recently was established as headquarters for Southern Louisiana and offshore operations.

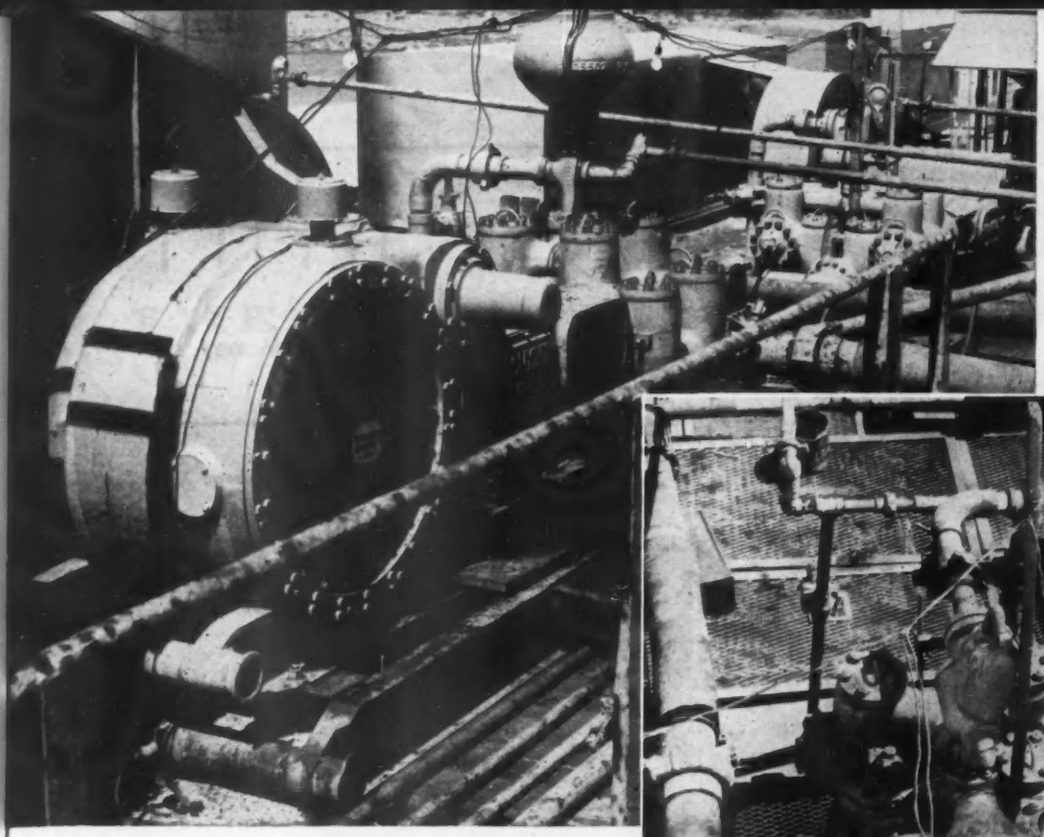
•

G. H. HERRIDGE has been appointed managing director of Iraq Petroleum Company and its associated companies following the retirement of SIR STEPHEN GIBSON on June 30, 1957. H. W. FISHER has been appointed executive director of the same companies with the title of joint managing director.

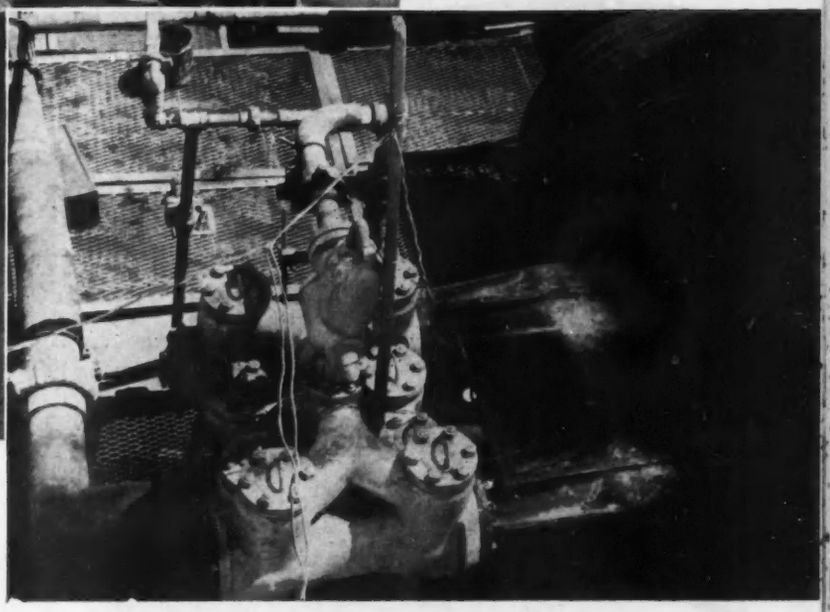
H. W. Fisher

•

RICHARD P. COCKE has been elected vice president of Trans-Arabian Pipe Line Company. In addition to this job, Cocke will continue as secretary and treasurer for Tapline.



"DEEP IN SOUTH TEXAS"



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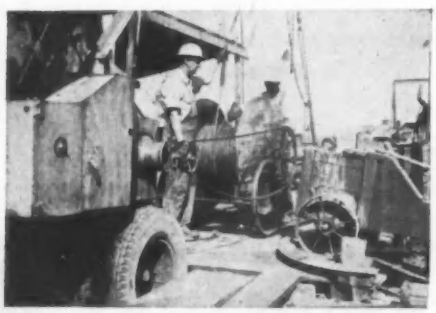
DRILLING HINTS

These **How-To-Do-It** Ideas Can Save You Money

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.

Label Parts Storage Bins as a Timesaver

To save time in locating repair parts, fittings and bolts, the bins and drawers in the parts and tool house can be labeled as shown in these two pictures. In addition to being a time saver, this also promotes good housekeeping in that parts are always in their right place.



Line Spooler Off Cathead Saves Time and Work

The line spooler, shown in use in the picture, saves much work and time when changing drilling and sand lines, and would work equally well on a rotary rig.

The frame of the reel holder is made of 2-inch pipe, which was wrinkle-bent to a half-circle, to enable the frame to be used to lift full spools off the ground. The shaft through the spool is made from a discarded common working barrel. Two-inch EUE couplings can be split to make the bearings. The sprockets and chain were obtained from a junk yard, and were originally on a threshing machine.

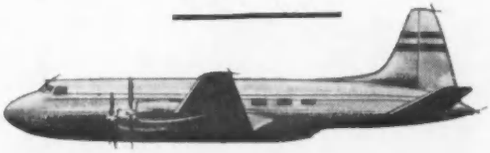
The larger sprocket is welded to the spool shaft; the smaller one is pinned to a short piece of 1-inch,

How-To-Do-It Ideas Earn Money, tool

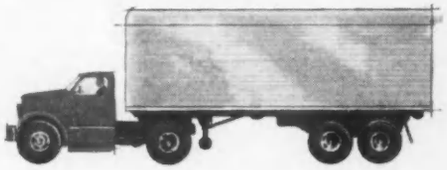
WORLD OIL editors want how-to-do-it ideas, so your favorite short cut or invention could put money in your pocket! Write down the substance of your latest ideas and send them in with a picture or drawing of the installation . . . if accepted, $10 for each idea will be yours. Send those money-making ideas today to Hints Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.

THE BEST BITS

and

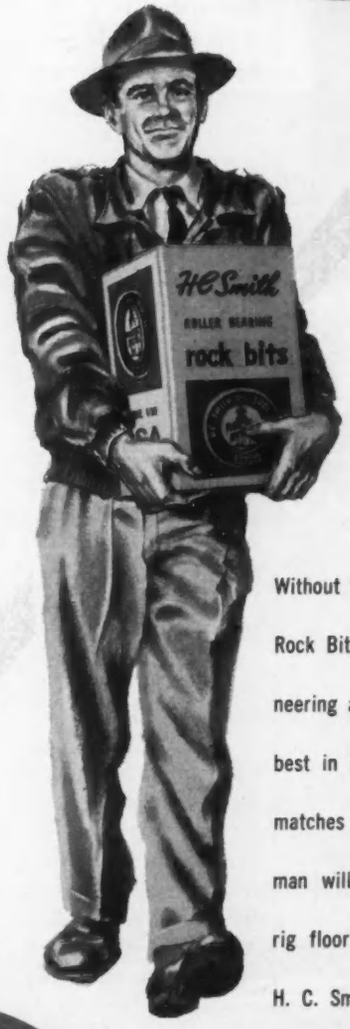


THE BEST



SERVICE

H C Smith ROCK BITS



Without reservation, we can say that H. C. Smith Rock Bits are best—because their design, engineering and quality control features have **proved** best in impartial tests. And H. C. Smith service matches the bits! Always, your H. C. Smith service man will have your bits waiting, ready on the rig floor when you need them. To do it, your H. C. Smith service man will use any means of transportation necessary to reach your rig with the best in bits—H. C. Smith Rock Bits.

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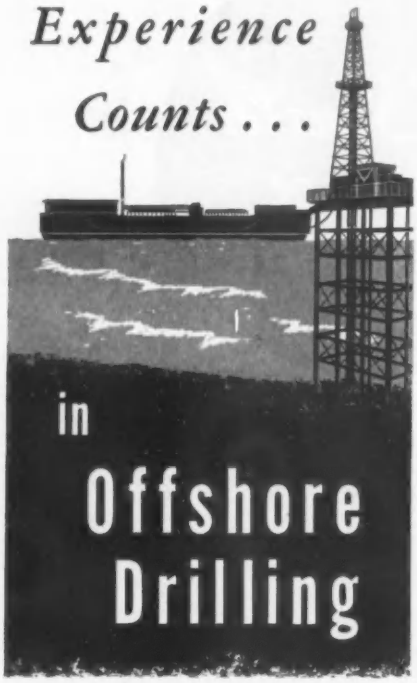

and so does . . .

EQUIPMENT

Reading and Bates operates two Levingston offshore drilling tenders with National Supply Co. Type 130 rigs, capable of drilling to a depth in excess of *20,000* feet in water *100* feet deep.

DEPENDABILITY

Reading and Bates is a dependable contractor with seasoned, experienced men operating their rigs. Contracts are fulfilled to the last letter.

KNOWLEDGE

Reading and Bates are specialists in offshore drilling. Their basic knowledge of offshore drilling problems, plus their wide experience, assures you of a job well done.

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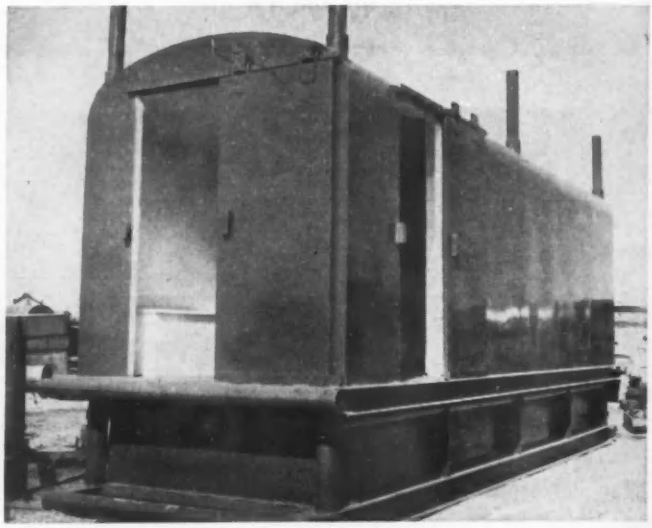
which is welded to a piece of 1-inch by 3-inch channel. Two 5/8-inch J-bolts attach the smaller sprocket to the rig cat-head. Chain tension is maintained with a chain-hoist or winch truck. A device similar to a lathe-dog transmits the driving power from the spool shaft to the spool.

Reduce Number of Rig Moving Loads



One of the biggest battles being waged by contractors today is to reduce the number of loads necessary to move his equipment from one location to the next and also to reduce the weight. One contractor has found a very suitable way of moving his doghouse and tool, or junk bin in one load. The tool bin is skid-mounted and the sides are built approximately 18 to 20 inches in height. The corner posts are made of 3-inch pipe that extend approximately 12-feet in to the air. The doghouse corner posts are built of 4-inch pipe and when assembled and completed, these 4-inch corner pipes for the doghouse fit down over the 3-inch corner pipes of the tool bin.

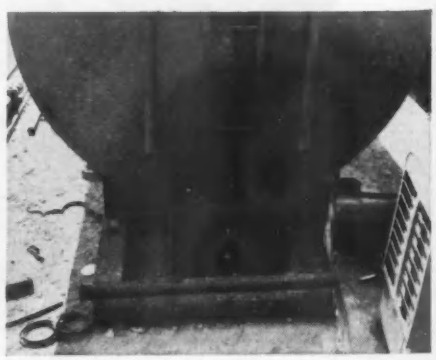
When moving onto location, the tool bin is spotted and the doghouse is raised by means of a gin pole to proper height. Then pins are inserted into holes in the legs so that the doghouse can be adjusted at floor level height.

Sliding doors on the doghouse, rather than the swinging doors, also contribute to the compactness of the unit and additional space is not needed for opening and closing the doors. This also prevents them from becoming beaten and damaged by mishandling and abuse.

When moving, this unit telescopes into the position shown above and makes one compact load of the tool bin and the doghouse. This is in comparison to the two loads ordinarily required for these two pieces of equipment.

Besides the above mentioned features, the tool bin skid base also forms a suitable base for the doghouse and additional shoring up and leveling is not needed.

Provide Freeze Box For Water Tank Valves



Where rigs might have to work from time to time in cold weather it is sometimes necessary to make a lot of changes and modifications to provide adequate protection. One such protective device is the freeze box to enclose all valves and water lines.

One contractor has solved this problem very well by extending a skid

base on his 500 barrel horizontal water tank so that the valves for the tank are covered. Around these valves is built a box of sheet metal that can be filled with suitable material to prevent water that is standing in the valves from freezing. The box is made a certain size so that there is adequate room for nippling up and still provide from 6 to 8 inches of insulation around the valves.

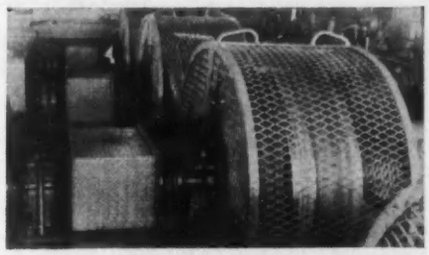
For a contractor with wide-spread operations it is not necessary to worry about whether or not this exact piece of equipment can be moved from moderate drilling conditions as Gulf Coast or West Texas into colder climates such as Canada or the Rocky Mountains. This freeze box also provides adequate protection for the valves against being damaged in transport.

Sign Prevents Accidents Around Electrical Work

Electrical repair work around the rig, whether on the derrick string, or any other string of lights, more particularly when around motor driven equipment, can be quite dangerous if all members of the crew are not informed that one of the crew members or an electrician is working on that particular piece of electrical equipment.

One contractor had a small sign made reading "Hands Off" with a string inserted in the top that could be hung on various circuit breakers and fuse boxes in the doghouse. When a crew member or an electrician had to work on a string of lights or electrical equipment, he broke the contact at the circuit breaker and then hung his sign on the handle of the circuit breaker. This warned other crew members or anyone else around the rig that somebody was working on this particular circuit, and that it was not to be energized.

This particular "Hands Off" sign used by one contractor has been credited with saving any number of injuries to crewmen on that rig.



Expanded Metal Guards Enhance Clutch Action

Friction type clutches on drilling rigs will perform better and last longer if ample cooling air can be provided. One of the simplest ways of assuring

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such air circulation is by the use of guards made entirely of expanded metal. Other advantages of such guard construction are; a decided saving in weight, ease of handling and ability to inspect parts enclosed.

On barge installations and other locations where slush pump and other V-belt drives are normally protected from the weather, such expanded metal guard construction contributes to longer belt life for the same reasons.

Use Traveling Skid Base For Drilling Line Reel

Two of the hardest items to handle in transport about the rig are blowout preventors and the reel with the drilling line. All of these can be handled simply by wrapping the chain around them and handling them with a winch truck. However when spotted on location and needed again for installation or in the case of the wire line for pulling through and cutting off the line, a real problem sometimes exists.

One contractor built a skid with appropriate base at one end to provide a cradle for the drilling line reel.

This reel was constructed of I beam iron and was raised high enough so that the reel turned freely when pulling the line off of the reel.

At the opposite end of the skid three small spools were fabricated from scrap metal and installed in such a manner that various sizes of blowout preventors could be placed on these spools and bolted down for transport. In this manner these various pieces of equipment can be moved in one load and handled very efficiently in moving onto location. The blowout preventors are protected against damage in transport and are readily available on this skid when

WAS THIS YOUR RIG?

The best blowout preventer won't work if your operating unit fails. Payne Blowout Preventer Operating Units have no equal for reliability and economy. Rugged, fast-acting Payne Pumps keep pressures up where they belong. New 2,000 psi service pressure Non-Separator Type Payne Accumulators have no *bladders* or *diaphragms* to cause expensive shut downs. They are assembled in multiple units for any required volume. Consider every angle in choosing your blowout preventer operating units – reliability first, availability, maintenance and, of course, economy. Payne units are doing a better, more economical job on preventer hook-ups throughout the oil areas of the free world.

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And now, with Warn Lock-O-matics, you have free-wheeling 2-wheel drive, or normal 4-wheel drive automatically, *as you shift!* When you need traction, you have it! When you shift to 2-wheel drive, you *always* have *free-wheeling* 2-wheel drive—with no drag, front gear whine, shimmy. Warn Lock-O-matics truly make "two vehicles out of 1!"

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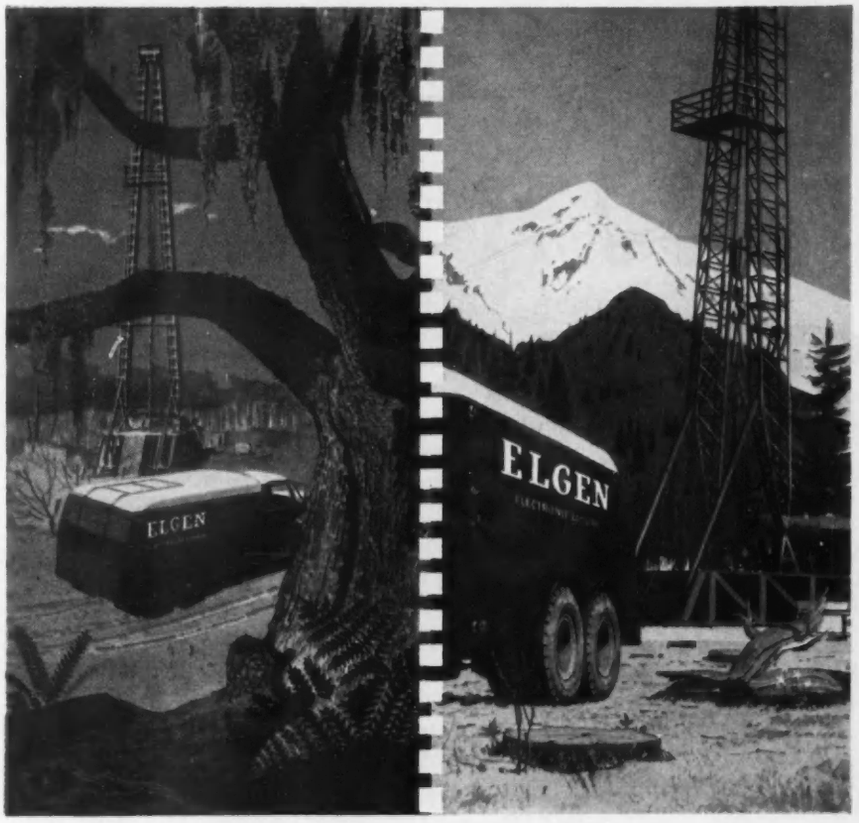
needed. The skid is spotted near the end of the walk where the reel is in handy position for stringing up and also for pulling through and cutting off.

Portable Spool for Catline Made of Scrap Material

On small drilling and work over rigs where it is necessary to compact all of the equipment into a small area it is not always possible to have the many conveniences of a large rig. This is especially true of such fixtures as spools for the catline.

One contractor with a small work-over rig solved this problem by welding a short section of two inch pipe in the corner of the guard rail that goes around his drawworks and motor platform. A spool was fabricated from scrap material of two inch pipe as shown in the photograph. A Y-brace was made of 2-inch pipe and the spool was made from scrap metal and sucker rods. The shaft of the spool was made of 1-inch pipe.

This spool and spool frame could be mounted in the 2-inch pipe welded to the guard rail and the catline kept on this when not in service. While on the move the spool can be taken down as the guard rail is dismantled and the walkways folded against the side of the truck. When rigging up it takes but a short while for two men to lift this spool and line set it in the bracket provided.



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These How-To-Do-It Ideas Can Save You Money

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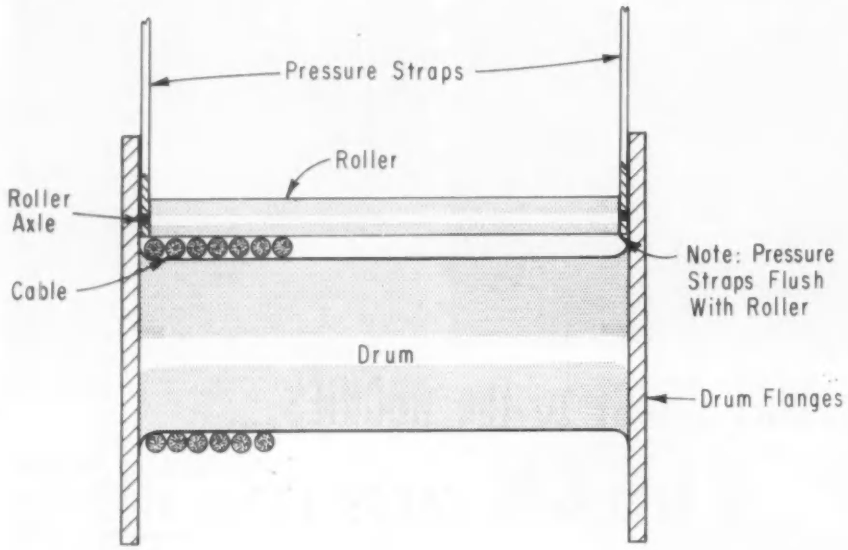
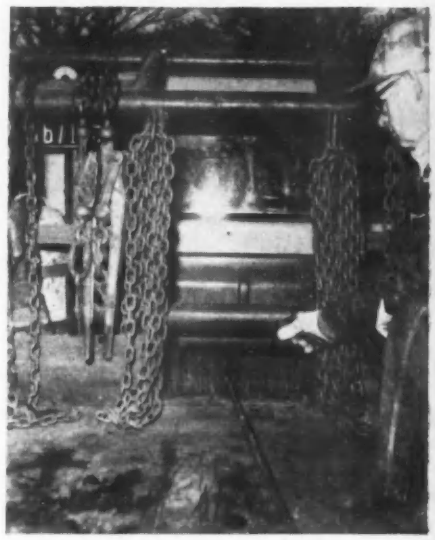




Spooling Device Increases Safety in Field

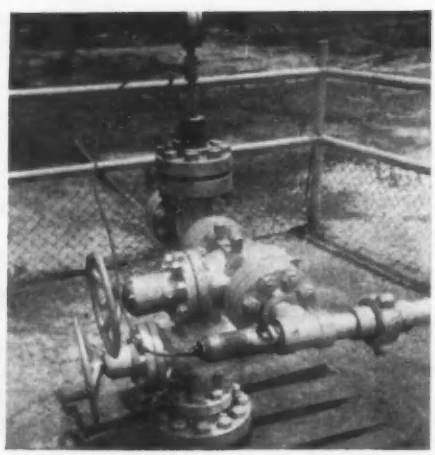
One company has increased safety conditions and reduced the hazards around winching operations in the field. The crew using this device has found winching operations safer and more efficient by installing a level wind attachment above the winch on a gang truck.

The spool which rolls freely, directly against the winch line, is mounted so that a heavy spring tension is held against the line as it is spooled. The roller has heavy spring mountings which cause it to exert a downward pressure on the line, forcing the line into the grooves of the previous layer on the spool, and assuring an even spooling of the line.

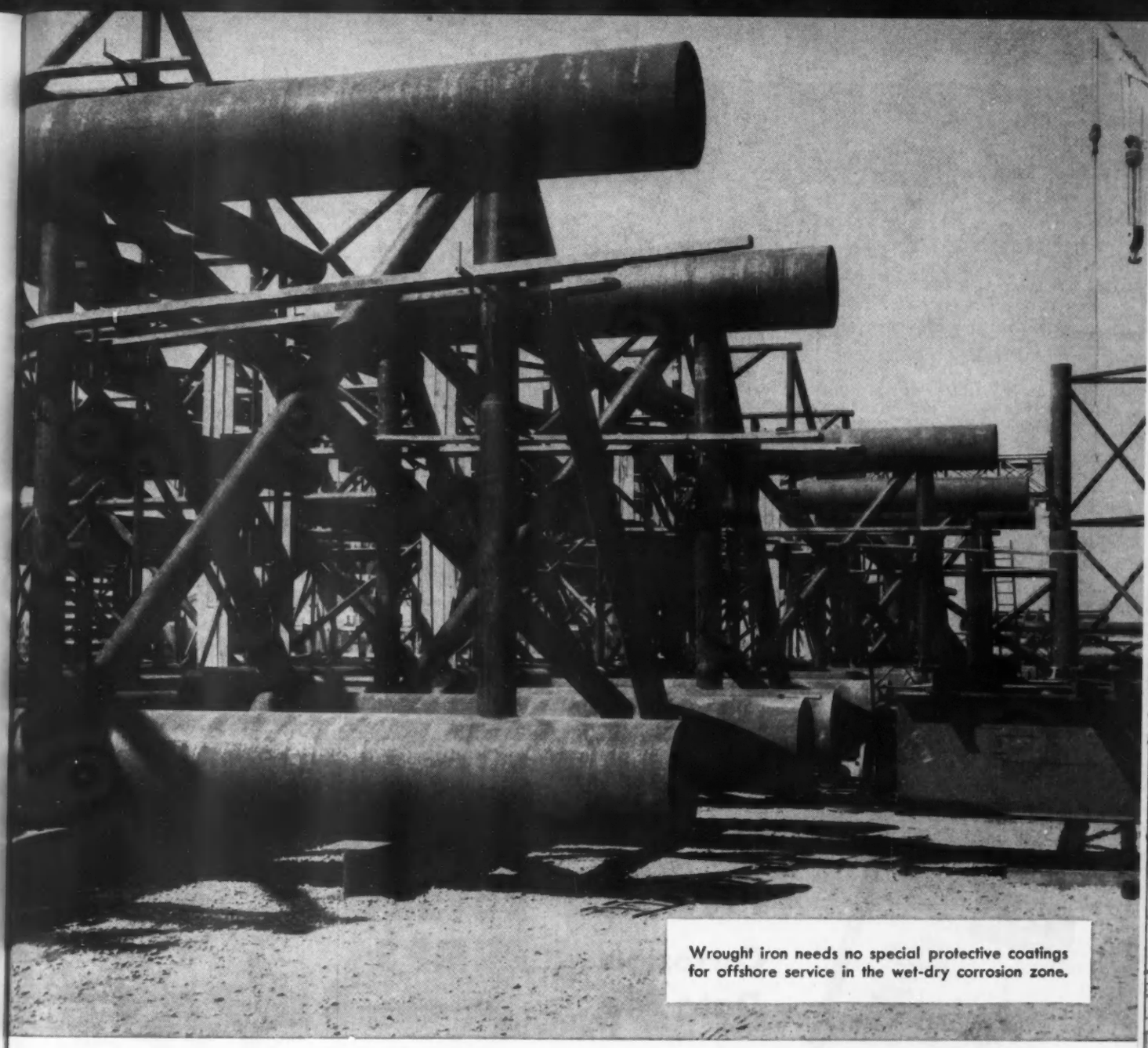
Without this installation it is necessary for one of the crew to hold the end of the winch line and guide it across the winch drum as it is spooled. This hazard exposes hands, gloves or clothing to catch on the hook at the end of the cable and often results in cuts and bruises from loose strands (wickers) of the wire cable.

Spring Loaded Piston Serves as Well Purger

Where a well is making sufficient water that it may load up and die, a simple purger was devised by one lease foreman. It consists of a choke with two openings, one for the standard rate of flow in order to obtain the well's allowable and the other to purge the well in case the pressure falls to a predetermined amount. This will greatly extend the natural flowing life of a well and save the installation of artificial lifting equipment for that time.



The regular production is run through a bean alongside of the center hole in the choke and is adjusted by changing the choke bean. The apparatus shown is connected to the center opening of the choke and consists of a spring loaded plunger which holds the plunger to the left and the choke open as long as the well pressure is low. When the well pressure



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Corrosion fighters have found a time-tested defense in their war against salt water attack.

Rugged wrought iron, supported by service records dating back 100 years in punishing salt water applications, has won wide acceptance for duty in the critical splash areas. Wrought iron's *built-in* protection makes it ideal for use where wet-dry corrosion threatens service life.

Wrought iron's protective qualities are also ideal for combating corrosion of structural piping, platform decks, hand railings, ladders and steps, dolphins, grating, conduit, casing and tubing, and oil lines to tank farms.

A talk with one of our field service engineers will show you how this material can help cut your corrosion control costs. Write us about your specific problem.

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Dependable

HERCULES STUFFING BOXES end Your pumping worries*

HERCULES Duplex Polished Rod Stuffing Boxes are constructed from high grade malleable iron (55,000 PSI Tensile Strength) and are rated 3,000 pound test. Flexibility and the cone-shaped Packing Rings are the combination of factors which make the HERCULES Stuffing Box without equal for any pumping situation.

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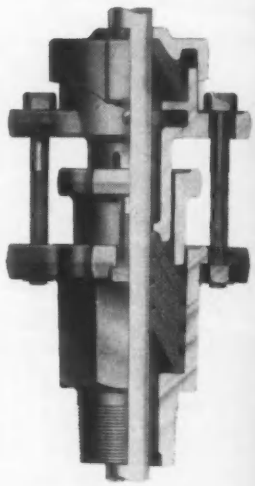

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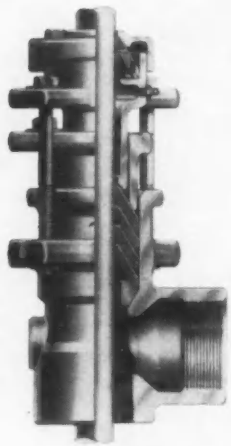
HERCULES "TEE TYPE" Stuffing Box is very compact, only 15" high. It is full opening which allows rods to be run or pulled without removing Stuffing Box body. It is furnished in 2", 2½" and 3" sizes with any API Tubing or Line Pipe Thread.



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rises to say 200 pounds, the piston goes to the right and the well rides on the choke bean which is open all the time.

Skid-Mount Transfer Pump For Operational Ease

When transfer from lease tank to pipe line is accomplished by pumping, one operator has developed a small skid-mounted rotary type pump that is driven by a small gasoline engine. This installation is very easy to install and is more or less a standard set-up in their operations.

It is a simple matter to install the suction-discharge lines and the gas line to the gas engine. Skid base provides a good foundation for this pumping unit so the cement base would not have to be laid. These pumps and engines are made up in the yard when it is known that another tank battery is being prepared. This saves time on tank battery erection. It is a fairly cheap method of installation especially where arrangement might be temporary.

Simple Flow Line Heater Breaks Down Emulsions

This simple flow line heater used for breaking down emulsions or melting paraffin is made from material picked up in a scrap yard.

This unit is set close to the well head on legs made from pieces of used 2-inch pipe. A length of 12-inch pipe is welded on each end around a piece of 4-inch which serves as a flue. The firebox is welded on one end and a door fitted to the front so that the

Can These Super-Hard Ball Valves Correct Your Pump Trouble?

If you have troublesome wells on your lease . . . wells that are hard to keep pumps in due to corrosive or abrasive fluids . . . and if the cause of your pump trouble is in the valves . . . the next time you're in your supply store ask them to show you a set of DuMore® Balls and Seats.

DuMore is a super-hard alloy composition that affords the highest resistance to wear caused by sand cutting, corrosion, or ball pounding. DuMore Balls and Seats are non-magnetic, they are corrosion-proof, and they run especially well in sour or sweet crudes, hydrogen sulphide gas, or salt water brine.

Considering its unusual metallurgical properties (an alloy of chromium, cobalt, and tungsten), it's a bargain at any price . . . yet DuMore costs less than premium grade ball valves. Moreover, the expenses you would eliminate in one pulling job alone would more than pay for fitting out your pump with DuMore Balls and Seats.

Try DuMore the next time you run a pump. You will be more than satisfied with the service they will give you, and you will agree that it's the "Best Ball and Seat in the Oil Patch."

DuMore® Balls and Seats

Made by **Harbison-Fischer • Fort Worth**

"Best Balls and Seats in the Oil Patch"

For more data on advertised products, use Readers' Service Cards, last page.

top half can be opened. A burner is made to form a jet by welding a ¼-inch nipple to a 1½-inch nipple and the gas line then connected from the casing head of the nearby well.

The stack on the opposite end, made by welding the 12-inch around the 4-inch, is made up with a nipple and ell into the 4-inch. The inlet connection can be placed on the bottom in front with the outlet on the side in back.

JENSEN'S No. 5 JACK is ideal for shallow wells

If you have an oil well from 1,000 to 1,500 ft. deep, you need a JENSEN No. 5 JACK—it's engineered to lift MORE oil for LESS money from any shallow well—anywhere!

The JENSEN No. 5 JACK has all the time-tested features of the other 13 JENSEN models—heavy welded post and beam, precision shaved gears, oil bath lubrication, double tapered roller type bearings, single and double gear reductions, one-man counterbalance.

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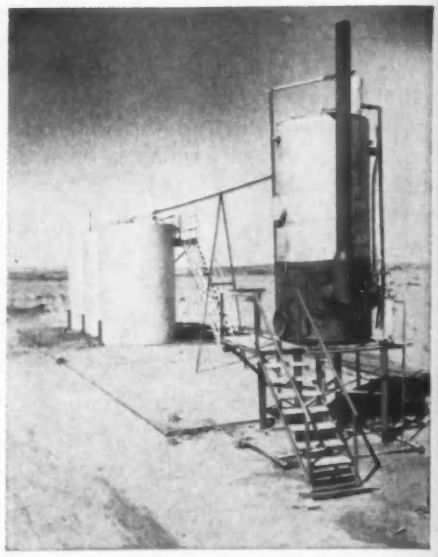
JENSEN JACKS



Elevated Heater Treater Gives Tank Gravity Flow

The operating life of a heater-treater may be greatly prolonged by placing it on a stand so that no pressure is required to push the oil over into the tanks. This also allows a minimum of gas in the oil and will cause the water to break out easier due to lack of agitation. Also, no back pressure valve is necessary as the heater-treater operates at atmospheric pressure.

The stand is made by simply measuring the distance that is necessary to raise the vessel for gravity flow and then cutting five pieces of 6-inch pipe two feet longer than the necessary length. These pipes are then set in concrete and a steel plate placed over the top. A winch truck may be employed to raise the vessel onto the stilts. The risers are then all extended the proper distance and the separator is put back into operation.

Small Metal Box Makes Handy Storage for Pumper

A small metal box approximately two feet long, 10 inches high and 18 inches wide, has been a handy storage box for one company's pumping

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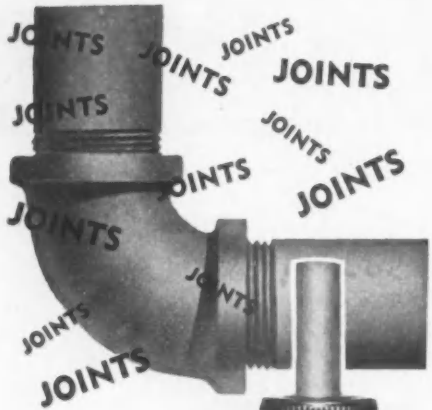

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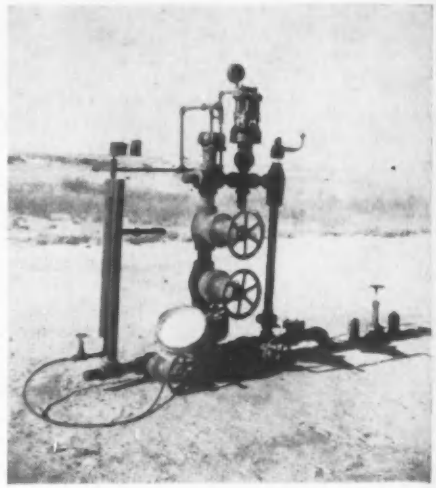
personnel. The box is installed on top of a two inch pipe near the entrance to battery for convenience. The box serves as storage space for such equipment as gage lines, thief samplers, shake out tubes and other items that would be of convenient use to the pumper. This keeps equipment out of the weather and in a known and convenient spot when needed, minimizing breakage and loss of equipment. The box is made of sheet metal with a top portion opening on two hinges that are spot welded to the metal.

Build Portable Sign With Concrete Base

If it is desirable to build a portable sign for use on a lease, such as the one in the picture, the idea used by one company is an inexpensive method that gives stability to the sign. A one inch pipe is cemented into a concrete base approximately 18 inches in diameter and three inches thick. At the top a thin metal plate is welded to the top portion of the one inch pipe and dimensioned according to the size of sign required.

The idea could also be adapted for use in larger signs by increasing the size of the base for stability. Small holes can be drilled into the thin plate at top of the stand and the sign fastened to the plate through the holes.

This type sign is very adaptable to any temporary installation such as around testing operations or repair of oil and gas line leaks. The portable sign is easily removed and would be out of the way when leveling with a bulldozer or other equipment is necessary, thus offering many advantages over a permanent sign around any temporary operation.



Use Snap Action Regulator To Purge Flowing Well

Where flowing wells will not flow continuously due to low pressure or a high percentage of water, a snap acting regulator will unload the well at the proper time. It is installed ahead of the choke on the tubing head with the pressure line connected back to the casing head and tubing head with control valves in between. A pot is installed on the tubing head connection so that if any liquid is carried over the top of the well it will collect, instead of running into the diaphragm chamber of the purger.

In operation, the purger is set to open when the pressure on the well head rises to a predetermined maximum and unload the slug of fluid. When the well has unloaded and the pressure falls, the purger snaps shut and waits until the pressure builds up again before unloading. If the well is producing cut oil, many times this system of operation will cause the oil to come out clean and possibly postpone the day that the well must be put on artificial lift.

Mount Run Ticket Mail Box At Tank Battery Entrance

An idea adapted for convenience of the switcher and pumper has been employed by one company using a crude run ticket mail box at the entrance to the tank battery. This box was installed on top of the main gate used to enter and leave the battery. Mail box is approximately 6 inches long made from scrap two inch line pipe with one end closed and the other made up with a cap plug. After making a run, the gager can remove the cap and leave the ticket in the box for the pumper to turn in to the

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Type RD Packer with Anchor and Plain Stinger

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Outstanding in performance because it operates perfectly with both zones flowing, high or low differential pressure; with either zone flowing, the other zone pumping; with both zones pumping; with either or both zones on gas lift; or for multi-zone injection — gas or water.

Outstanding in advantages because it completely isolates each zone from the other and from the casing; provides full opening long string to lower zone; permits either string to be pulled or run separately.

Guiberson's RD packer does complex dual zone jobs so well that operators tell us it's their best investment for dual string production. Ask your Guiberson representative about installation and auxiliary equipment recommendations.

Guiberson's RD packer has smooth operating dovetail slips of heat-treated alloy steel. Packing rubber is one-piece sleeve type — will not vulcanize in the well, made of Guiberson's special oil and gas resistant compound. You can get the RD packer with or without anchor, and a choice of stingers, plain or with jay-hook. Piston slips have extra large gripping area, are heat-treated alloy steel and keyed to anchor body to maintain proper alignment. Get the Best — Get Guiberson.

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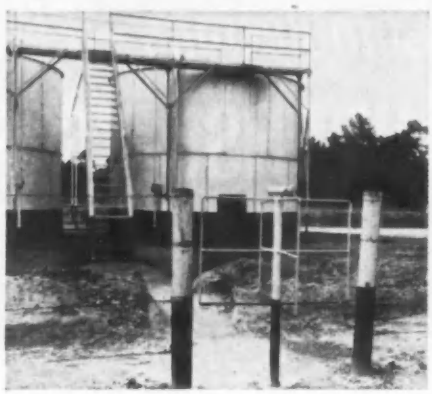

proper authorities. This device keeps run tickets in a safe place and out of the weather.

Scrap Rod Anchors Hold Desired Valve Position

Around battery installations, where valve hand wheels are usually above but near ground level, one company has utilized scrap rods to build anchors to keep valves in the operating position desired. This method of anchoring a valve control is especially useful where it is not necessary to open or close a valve frequently.

The rod is fashioned in the manner shown in the picture with one end hooked over the hand wheel and the other end driven a substantial distance into the ground. Should it become necessary to open or close the valve, the anchor can easily be removed.

Anyone entering the battery can easily see an anchored valve is set at a predetermined position. This method of anchoring hand wheels eliminates any change in valve position due to vibration and pulsation. Once a valve is anchored the pumper can tend to his duties knowing the required open and closed valves are in proper position.

YOU GET *4-cycle* DEPENDABILITY AND *Light weight* TOO . . . IN AN

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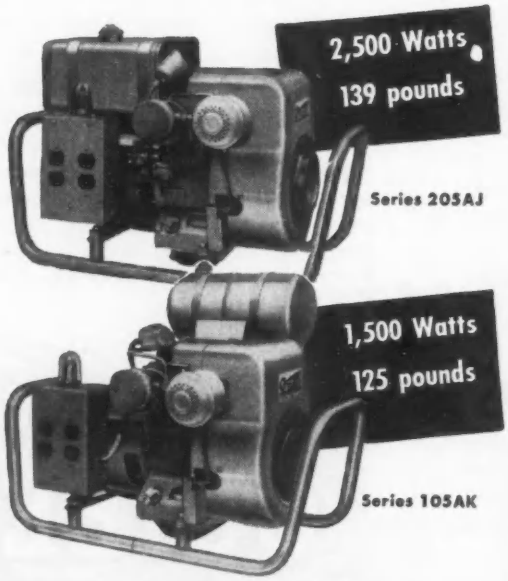

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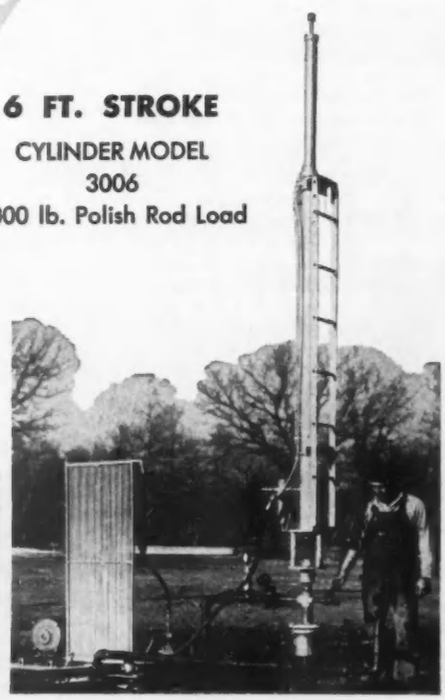

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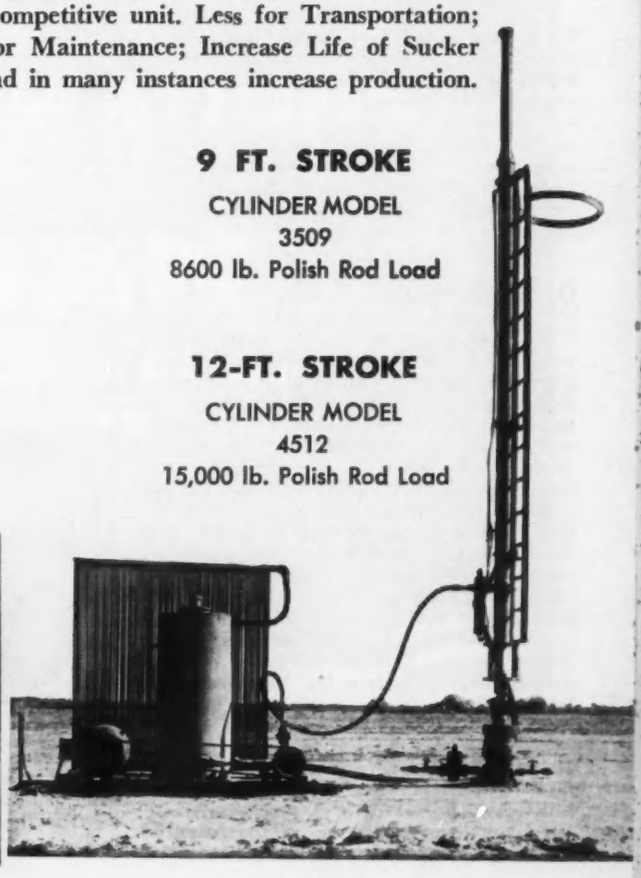
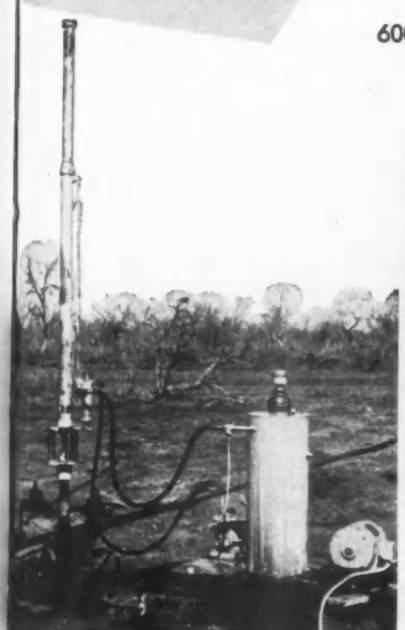
CYLINDER MODEL
3509
8600 lb. Polish Rod Load

12-FT. STROKE
CYLINDER MODEL
4512
15,000 lb. Polish Rod Load





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What's Happening . . .

. . . *Among Men* in the Industry

L. T. White

Tom DeBow

L. T. White and **Tom DeBow** have been elected vice presidents of **Cities Service Petroleum, Inc.** In addition, DeBow was elected to the board of directors. White has served on the board since 1938. Both veteran Cities Service executives, White is manager of the Department of Business Research and Education of Cities Service Petroleum, Inc., and DeBow is director of advertising and news.

•

D & D Drilling Co., wholly owned subsidiary of Falcon Seaboard Drilling Co., Tulsa, has appointed the following executives. **E. L. Walton** has been appointed general manager; **Mahlon A. Mundy**, drilling superintendent and **Ernest Neipp** has been made office manager of the Falcon Seaboard subsidiary in Venezuela. Walton worked for 18 years in Mid-Continent and California oil fields, was executive of International Petroleum Corp. in Peru, and worked from 1948 to 1954 for the Mene Grande Oil Co. in Venezuela, before joining the D & D organization. Mundy's career in the oil business has been almost exclusively in South America, having worked in Colombia and Chili. Before joining D & D in 1956, he was drilling superintendent for Venezuela Atlantic Oil Co. in that country.

•

Robert V. Phipps, formerly employed by Gulf Oil Corporation and Texas Crude Oil Co. in Fort Worth, Texas, has joined the Geological department of the **Atlantic Refining Company** in Midland, Texas.

•

Colorado Oil and Gas Ltd. announced the appointment of **Norman W. Martison** as exploration manager. Prior to entering the oil industry, he spent five years in mining in Ontario and Quebec. He has had considerable experience in eastern and western Canada in the oil industry, filling various capacities for 12 years with Shell Oil Company, including 3½ years as division exploration manager in Regina.

•

Bert C. Timm has been named chief geologist for **Sunray Mid-Continent Oil Co.** Timm previously served as division geologist for Oklahoma and also as coordinator of the company's geological and geophysical activities. He joined Sunray in 1950 as district geologist of the Southern Louisiana district. He was named division geologist in 1952. **Thomas A. Clote**, formerly division geologist for Sunray's West Texas-New Mexico territory, has been named division geologist for the Oklahoma division, the area previously handled by Timm. **Walter J. Slagle**, district geologist located in Oklahoma City, has been promoted to division geologist for the West Texas-Southeast New Mexico area, replacing Clote. He has moved to Tulsa on his new assignment. **Russell J. Ford**, formerly senior geologist in the Oklahoma City office, has been promoted to district geologist, the post previously held by Slagle. Slagle joined Sunray in 1951 and, at the time of his new promotion, was serving as senior geologist and geophysical-geological coordinator for the Oklahoma City district.

•

Hines H. Baker has been elected a vice president of **Standard Oil Company (New Jersey)** and a member of the executive committee. Baker was formerly president and a director of Humble Oil & Refining Company, a Jersey affiliate. Baker was president and chief executive officer of Humble from May, 1948, until his recent resignation. He began his career with Humble in 1919 as a member of the Law department.

•

Dixilyn Drilling Corporation has announced that **H. S. Brigham** was elected executive vice president. This follows Brigham's resignation from Gulf Oil Corporation as zone manager of production for the Laurel, Miss., zone. Prior to Brigham's transfer to Laurel, Miss., in 1955, he was California division manager of production for the Western Gulf Oil Company, a wholly owned subsidiary of Gulf Oil. He brings with him over 25 years of experience in the petroleum industry, the last 14 of which have been in the employ of the Gulf companies.

H. S. Brigham

•

The University of the South, at Sewanee, Tenn., awarded **Henry C. Cortes**, vice president and director of **Magnolia Petroleum Company**, the honorary degree of doctor of science at commencement exercises recently. Cortes attended Sewanee Military Academy and The University of the South. He now has management charge of coordinating Magnolia's offshore operations and of the company's field research laboratory near Dallas.

•

Richard Robert Anderson was appointed administrative assistant of **Sun Oil Company's** Production department. Anderson moves to Sun's general offices in Philadelphia from the Gulf Coast division where he has been assistant regional superintendent at Lafayette, La., since 1954. He has been engaged in various aspects of petroleum engineering and administration with Sun Oil since 1938. In his new post Anderson succeeds **Ted C. Stauffer**, who recently was named director of Sun Oil's Foreign Production Operations.

•

Roger Wiley

Roger Wiley was appointed chief geologist of **Kirkpatrick and McGuire**, Shreveport, La., petroleum engineers and oil property operators. With United Gas Co. the past 18 years, Wiley was a geologist with Union Producing Company just prior to his accepting the new post.

•

L. J. (Lew) Hubka, Jr., former division geologist for Shell Oil Company and for the past two years chief geologist for Beck Oil Co. in Houston, has announced immediate plans to enter the petroleum consulting field. Hubka is presently setting up offices in the Southcoast Life Building and will specialize in the geology of the Texas and Louisiana Gulf Coast area.

•

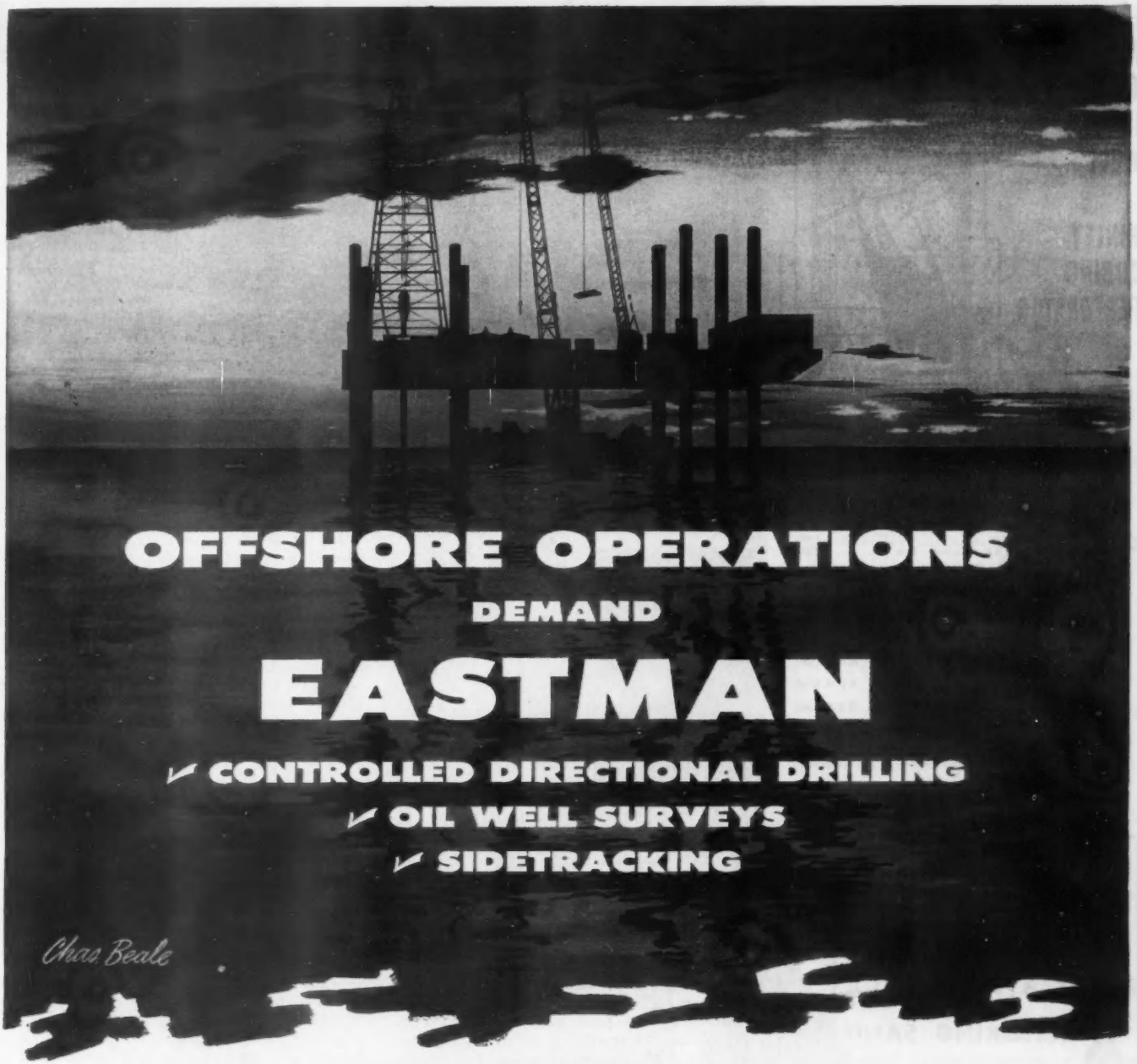
Joe N. Gifford, junior geologist for **Sinclair Oil & Gas Company** at Wichita, Kansas, has been promoted to intermediate geologist and transferred to Sinclair's Offshore division headquartered at New Orleans.

•

C. O. Hopper has been named division drilling superintendent for **Pan American Petroleum Corporation's** Canadian division, and new district and field superintendents have been named at the firm's Alberta and Pembina offices. **W. M. Jones** has been promoted to district superintendent of the Alberta district, and **W. M. Bogert** was promoted to field superintendent of the Pembina producing area. All three men have considerable Canadian oil experience. The new division drilling superintendent position was established by the company because of its heavy schedule of drilling activities in Alberta and British Columbia. Prior to his appointment as division drilling superintendent, he was district superintendent of Pan American's Alberta district. Prior to his latest promotion, Jones was field superintendent of Pan American's Pembina area. Bogert was a production foreman at Pembina prior to this promotion.

•

H. H. Carrick, Jr., has been named superintendent of the Southern division of the Production department of **General Petroleum Corporation.** Carrick succeeds A. W. **Titus**, recently retired. Other promotions announced were **H. C. Carrothers** to production superintendent of the Southern division, and **V. M. Reed** to senior production foreman at Wilmington, Calif. Carrick joined General Petroleum in 1940. Prior to his promotion, he was production



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FORT MORGAN, COLORADO—C. A. White...919
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Horne Well Service Co.....3-5396
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superintendent for the Southern division. Carrothers held various positions in oil field drilling operations at Ventura and Wilmington since joining General Petroleum in 1923. He was advanced from senior production foreman at Wilmington. Reed, who joined the company in 1923, was promoted from the position of production foreman at Santa Fe Springs, Calif.

•

J. W. (Win) Miller was appointed assistant to the president of **Union Oil Company.** He will make his headquarters in San Francisco where he will represent the president in all matters affecting the company's activities in the Bay area. Prior to this appointment Miller was executive vice president of Brea Chemicals, Inc., a wholly owned Union Oil subsidiary and had spent 20 years in Union's Marketing division.

•

O. N. Miller was appointed as a vice president of **Standard Oil Company of California.** Miller has been a vice president of Standard of California, Western Operations, Inc., the company's operating subsidiary in the seven western states, Alaska and Hawaii. Miller joined California Standard in 1934 and he served as general manager of Standard's Manufacturing department for eight years, from 1946 to 1954. His experience covers both the research and refining fields, including planning and design of the Ras Tanura refinery in Saudi Arabia.

O. N. Miller

•

J. A. Vickers, president, **The Vickers Petroleum Co., Inc.,** has been commissioned by **Governor George Docking** to serve on the Governor's Oil Advisory Committee for the State of Kansas. Most active in industry affairs, Vickers was recently elected a vice president of the Western Petroleum Refiner's Association at the group's 45th annual meeting in San Antonio, Texas. Vickers is also a vice president and director of the Mid-Continent Oil and Gas Association, a director of the Independent Petroleum Association of America and a director of the Kansas Independent Oil and Gas Association.

•

Husky Oil Company announced the appointment of **Jesse D. Winzenried** as assistant to the president in a staff capacity. Winzenried has been administrative coordinator for Husky since April, 1956. In his new capacity he will fill the position left vacant last October when **Maurice E. Smith,** formerly Nielson's staff assistant, was named vice president, finance. Prior to joining Husky, Winzenried was director of field service research for Tax Foundation, Inc., in New York.

•

Grover E. Ledlie, Jr., was appointed administrative assistant to the president, in charge of exploration for **Falcon-Seaboard Drilling Co.,** Tulsa. Ledlie was most recently a private petroleum consultant in Denver. He started his business career with Phillips Petroleum Co. and later served as landman and division manager of Globe Oil and Refining Co. and Lario Oil & Gas Co. In that capacity he worked in both Canada and the Rocky Mountain area.

•

E. D. Klinger has retired as chief geologist for the **Lion Oil Division** of Monsanto Chemical Company, El Dorado, Ark., to become a consultant with offices at 1402 Beck Bldg., Shreveport, La. He had been with Lion since 1936. In 1922, he joined Empire Gas and Fuel Co. and worked for them and for the parent, Cities Service Company, in Oklahoma, Kansas and Texas until transferred to the New York office of Cities Service in 1930 where worked until 1932 on special oil and gas reports on the Rocky Mountain Region, the West Coast and Western Canada.

E. D. Klinger

In his new activities Klinger will specialize in evaluation of oil and gas properties, advice and recommendations on exploratory drilling in the Mid-Continent Permian Basin and Rocky Mountain regions, appear before regulatory bodies as a witness in hearings involving proration and other oil and gas matters, advise on development of producing properties, supervise surface and subsurface exploratory programs and engage in geological supervision and interpretation of geophysical surveys.

•

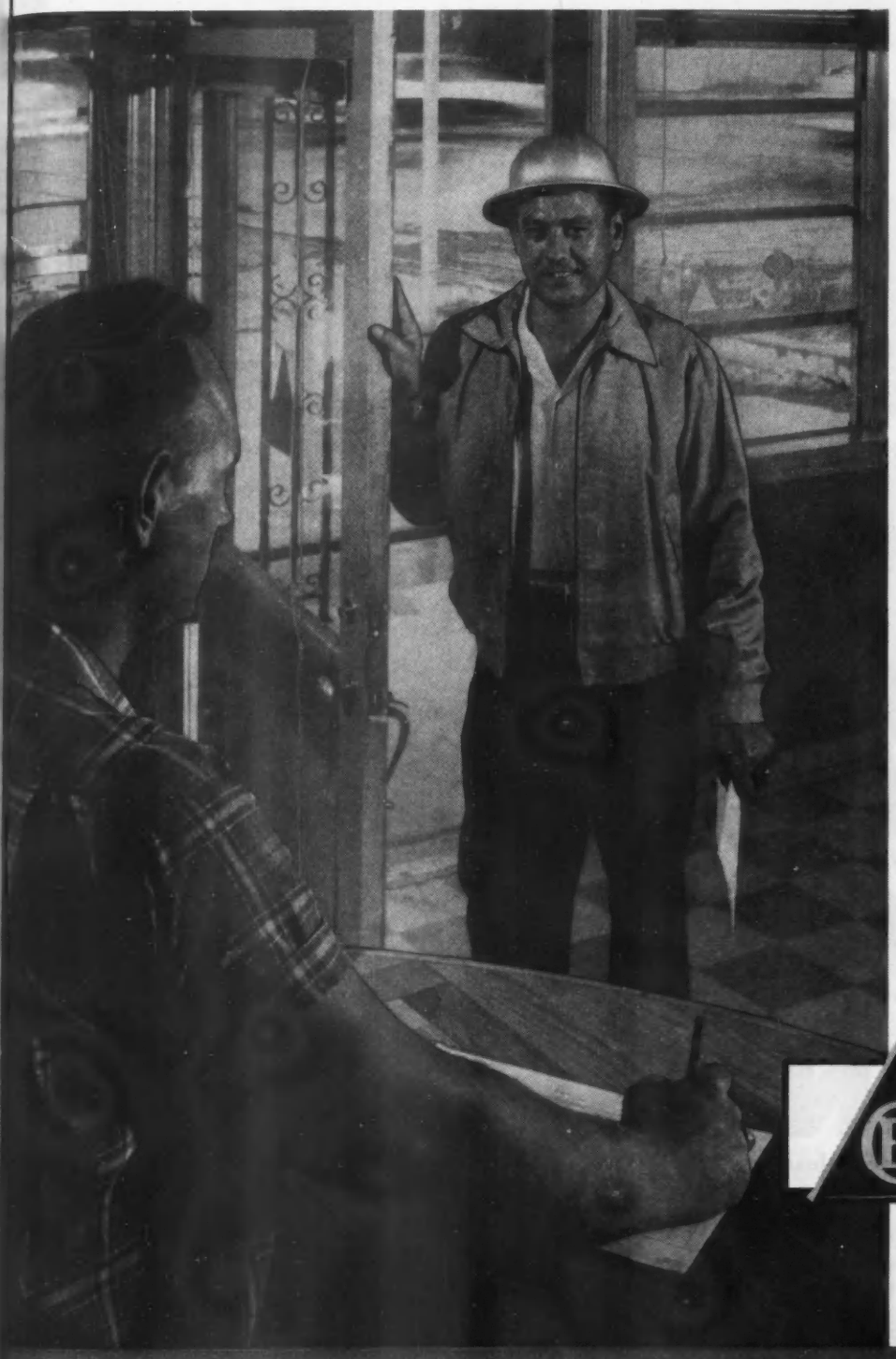
Sinclair Oil & Gas Company has elected a new vice president and assigned three men to new management posts. **G. D. (Dan) Almen, Jr.,** vice president and manager of the Offshore division at New Orleans, has been named manager of the Houston division. **R. A. Wright,** assistant to the president was assigned to the Offshore division. He was assistant division manager of the Denver division prior to his recent transfer to New Orleans. **Dick T. Fenwick,** executive assistant in Sinclair's Production department in Tulsa, has been named assistant division manager of the Denver division, succeeding Wright. The changes result from the expansion of Sinclair's executive staff in Tulsa. In his new assignment at Houston, Almen will succeed **J. B. Kennedy,** vice president and division manager, who is being transferred to Tulsa as executive vice president for operations, a newly-created post.

•

L. W. Baker, former president of the Baker-Munday Drilling Co., Tulsa, announced that he has purchased the interest of A. G. (Doc) Munday and has dissolved the Baker-Munday Drilling Co., as of April 30. He has joined the firm of **Schoenfeld-Hunter-Kitch Drilling Company,** Tulsa, who are operating extensively in the West Texas and New Mexico area, maintaining an office and yard in Odessa, Texas.

•

Sohio Petroleum Company has combined its Houston and Tyler district production operations. With headquarters at Tyler, it will encompass all producing properties within the Gulf Coast division portion of Texas, as well as north Louisiana and southern Arkansas. Producing properties



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Continental-Emsco Company C.A., Caracas, Venezuela • Plants: Los Angeles • Houston • Garland, Texas • *Representatives in All Principal Oil Fields of the World*

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P726

in Mississippi, now under Tyler, will be transferred to the Lafayette district, **L. R. Records,** superintendent. In keeping with this move, the following personnel changes will be made: **Jim Gibson** will remain district superintendent of the new Tyler operations district. **Joe Cobb** will be transferred to the Gulf Coast division office as assistant to the division production manager, **B. W. Whiteley,** acting in a staff capacity. **J. E. Owens,** presently staff assistant to the division production manager, will become staff assistant to the Gulf Coast division manager, **G. H. White. P. A. Ziegenfuss** will be transferred to Tyler as district clerk.

•

Pan American Petroleum Corporation has announced some changes. **John L. Severson,** formerly district geologist in the Denver district Exploration office, has been promoted to position of district exploration superintendent at Bismarck, N. D. **E. K. Droullard,** area geologist in the Pan American Denver district Exploration office, has been promoted to district geologist. Droullard succeeds Severson.

•

Tidewater Oil Company has made three appointments in its Production department. Involved are **R. N. Miller,** area engineer at Drumright, Okla., transferred to area engineer at Hobbs, N. M. **W. H. McPhail,** area engineer at Sallyards, Kansas, will move into the post vacated by Miller. **C. J. Stumhoffer,** former field engineer at Sallyards, has been named area engineer of Kansas area.

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makes for easier handling at all times.
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permit repacking while the wire line is in the hole.
These wire line strippers represent an outstanding advance in design and construction of tools in this class.
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Myron C. (Mike) Kiess, veteran geologist with Sunray Mid-Continent Oil Co. and the former Mid-Continent Petroleum Corp., has resigned to become a consultant in geological and geophysical work. Kiess was geological manager for Sunray Mid-Continent, assuming this position in 1955 at the time of the merger of Sunray Oil Corp. and Mid-Continent Petroleum Corp. He was manager of exploration for Mid-Continent at the time of merger and had previously served as chief geologist for the firm. He joined Pure Oil Co. in 1925 and remained with the organization for 24 years.

Myron C. Kiess

•

James A. Haertlein

James A. Haertlein has joined **William J. Carey** as geologist in Dallas. Haertlein was most recently chief geologist for Nortex Oil & Gas Corporation, Dallas, and was associated previously with Amerada Petroleum Corporation and Standard Oil Company (New Jersey).

•

Gordon R. Hinz, a former consulting petroleum geologist in Houston, has been named a geologist for the **Commonwealth Oil Company** of Houston. He was a geologist for the Sohio Petroleum Company for six years, working in both Texas and Canada, and resigned in September, 1956, to become a consulting geologist in Houston, the position which he held before joining Commonwealth.

•

Dr. M. L. Thompson, currently head of the Department of Geology at the University of Kansas, Lawrence, Kansas, has accepted the position of principal geologist in the Geological Resources section at the **Illinois State Geological Survey,** Urbana, Ill.

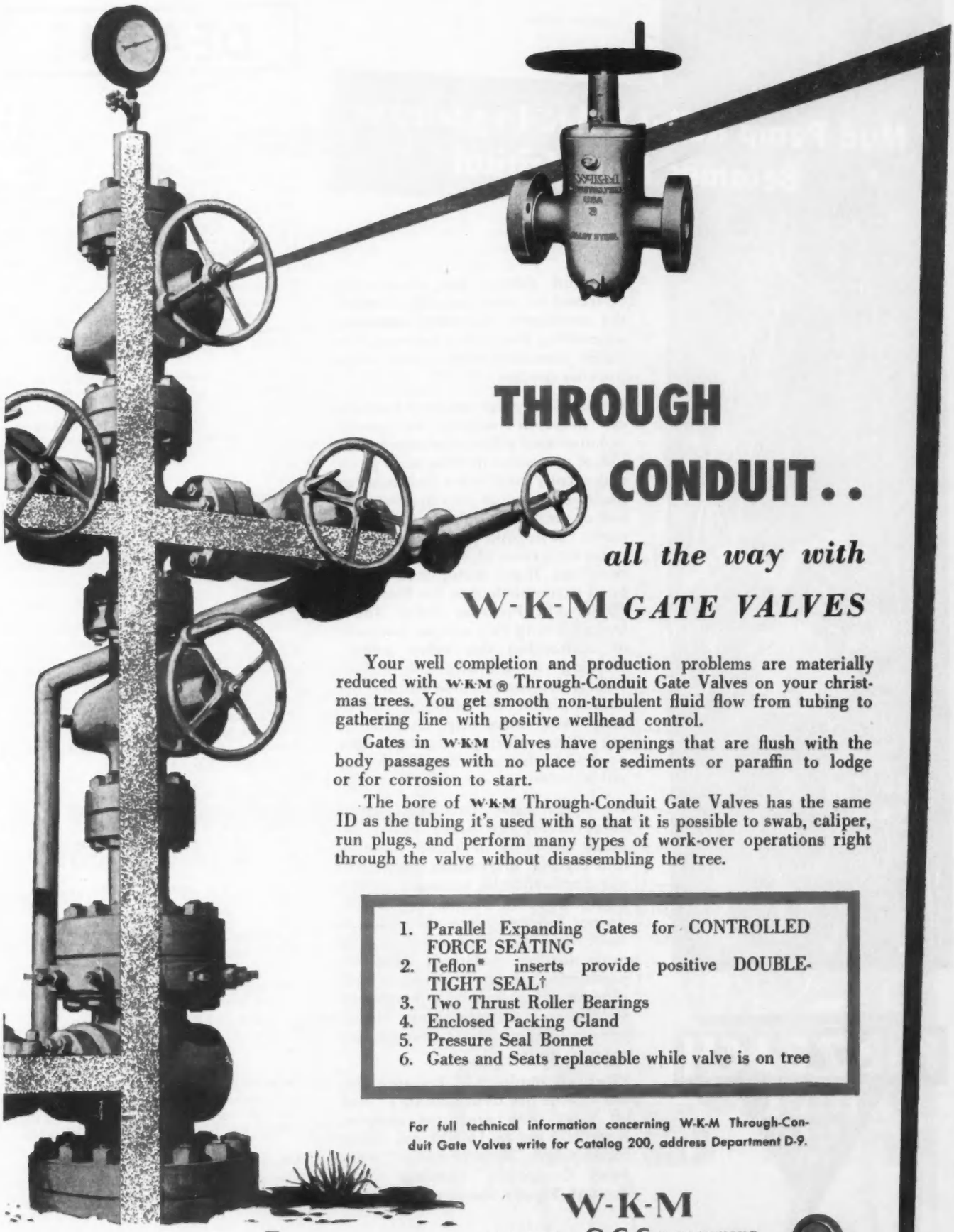
•

Dr. Hubert Risser, currently assistant professor in the Department of Mining and Metallurgical Engineering at the University of Kansas, Lawrence, Kansas, has accepted the position of mineral economist in the Mineral Economics section at the **Illinois State Geological Survey,** Urbana, Ill.

•

Warren Petroleum Corporation announced that **R. A. Hobbs,** formerly district geologist with headquarters in Tulsa, has been promoted to assistant chief geologist and transferred to the Houston office. **J. R. Simmons,** formerly assistant district geologist for the New Mexico district and stationed in Roswell, replaces Hobbs as district geologist for the Oklahoma, Kansas and Texas Panhandle district.

For more data on advertised products, use Readers' Service Cards, last page.



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Gates in W-K-M Valves have openings that are flush with the body passages with no place for sediments or paraffin to lodge or for corrosion to start.

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1. Parallel Expanding Gates for CONTROLLED FORCE SEATING
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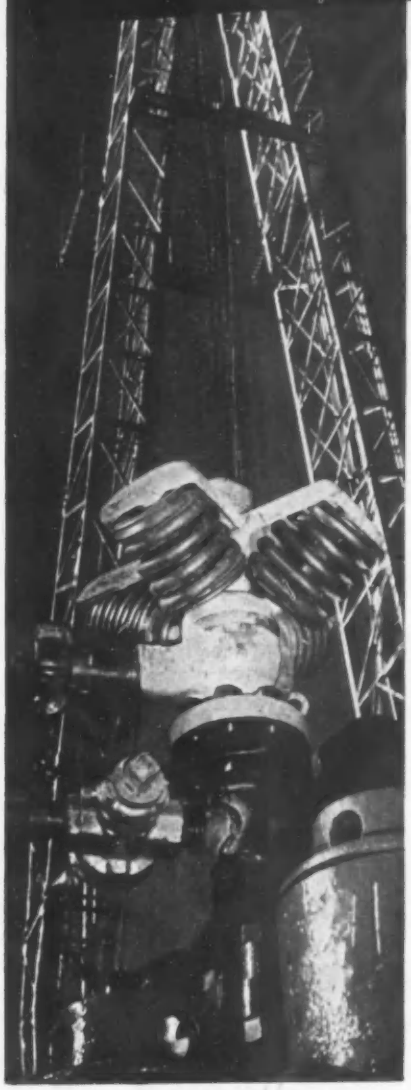
Mud Pump Relief Valve Importance Becomes More Critical



As mud pumps are necessarily operated at near capacity to meet the constantly increasing demands on drilling circulating systems, the safety demands on the relief valve become greater.

Responsibility for reducing hazards of personal injury, equipment damage and drilling trouble by relief of excessive drilling mud pressures, calls for a valve that assures positive instantaneous pressure relief at maximum volume and automatic restoration of circulation upon correction of the overloading condition. These requirements have been accomplished in the Kinzbach Model 112 Pressure Relief Valve by combining two unique methods of restraining the valve piston, yielding a characteristic action from a decreasing force against the valve piston on opening movement, and conversely, an increasing force during closure. This assures higher effective lift during valve action.

When excessive circulating pressures occur, the valve either repeats its cycle of rapid opening and closing, or remains open until the obstruction is removed or the pump stopped. Momentary blocks do not require pump shutdown to reset the valve. Movement of fluid may not be materially affected, preventing danger of stuck drill pipe as might occur with arrested circulation. Compounding Heads are available where pumps are used in series.

Kinzbach Model 112 Pressure Relief Valves are available in 2" and 3" sizes with pressures ranging from 500 psi to 16,500 psi. Write for complete data or consult your new Composite Catalog. Sold through Supply Stores everywhere.

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DEATHS

J. E. Duff, 79, pioneer oil operator, died July 24 in Houston. He was a partner in the late H. R. Cullen's first oil strike in the Pierce Junction field.

Ralph E. Sleppy, 69, retired oil company official, died June 17. Sleppy retired in 1953 as vice president of Sunray Coastal Pipe Line Co., then a wholly-owned subsidiary of Sunray Oil Corp. He joined the former Barnsdall Oil Co. in 1916 and headed that company's crude pipe line activities before the merger of Barnsdall into Sunray in July, 1950.

Oliver A. Sewell, 73, an independent oil producer, died June 16.

Millard F. Waters, 66, president of the Waters Oil Co., died June 15. Waters organized the Waters Oil Co. in 1946 with E. I. Hanlon and J. H. Boyle. He formerly was president of Hanlon-Waters, Inc., which he also helped organize in Tulsa in 1929.

Arthur W. Jones, 52, district production superintendent, Midstates Oil Corp., Dickinson, Texas, died June 14.

Arthur Elbert Fisher, 78, former superintendent of the old Waite Phillips Co., died June 6 in a Pawnee, Okla., hospital.

Samuel K. C. Kopper, 42, assistant to the chairman of the board of directors of the Arabian American Oil Company, died recently at his home in Larchmont, N. Y. Prior to joining Aramco in 1953, Kopper served as deputy director of the State Department's office of Near Eastern Affairs and as consultant of the assistant secretary of state for Near Eastern, South Asian and African affairs.

Edward C. Wolf, 60, assistant purchasing agent for Sunray Mid-Continent Oil Co., Tulsa, died at his home, June 2. He had been connected with the oil business in Tulsa many years. Formerly he was employed by the old Frick-Reid Supply Co. and later was associated with Waite Phillips.

E. Claude Coe, 73, former Tulsa drilling contractor, died June 28.

Clarence Roland Fortner, 75, retired oil drilling contractor, died June 30.

Wesley M. Smith, 78, oil man and lead and zinc mine owner, died July 1.

Frank A. Elliott, 72, pioneer oil driller and producer, died June 19. In 1911, he and his brother, the late W. C. Elliott, formed the Elliott Brothers Drilling Co.

Albert L. Green, 64, died June 20 at a Chicago hospital. He had been associate general counsel of Standard Oil Company (Indiana) since 1948.

D. K. (Dud) Bowen, 59, manager of the Producing division of Mountain Fuel Supply Company, died June 4 at a Rock Springs, Wyo., hospital. His accumulated service to Mountain Fuel Supply Company and its predecessors amounted to approximately 39 years.

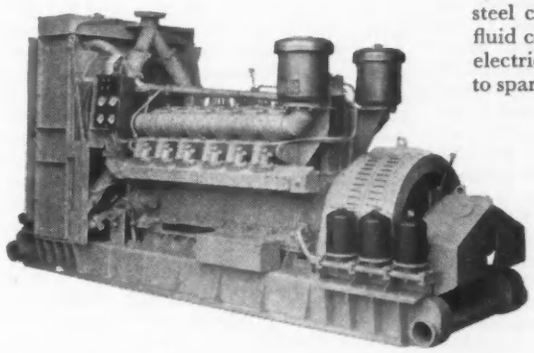
For more data on advertised products, use Readers' Service Cards, last page.

Camels or dromedaries?

Doubt has been expressed often on this question but in definition the two are identical, the camel being described as a large ruminant quadruped, the Bactrian having two humps on the back and the Arabian, or dromedary, one only.

To Middle East oil men the latter is a familiar part of the local scene, an animal that puts in a great deal of hard work, at surprisingly low fuel cost; virtues, they will tell you, displayed also by the Paxman drilling engines—with the added attraction of a far sweeter temper.

Having reached this point, we venture to add that these Paxman "Package" sets have been developed from 16,000,000 hours drilling experience, by a team which knows the answers to the power demands of drilling men and has produced two ranges of engines known everywhere for their sound performance, rugged construction and dogged dependability. These are, 7" bore, 128 to 800 s.h.p. with fluid coupling, torque converter, power take-off clutch, or diesel-electric drive and a 70% interchangeability of wearing parts; 9¾" bore, 450 to 1,750 s.h.p., of fabricated steel construction with fluid coupling or diesel-electric drive, giving power to spare for the largest outfit.



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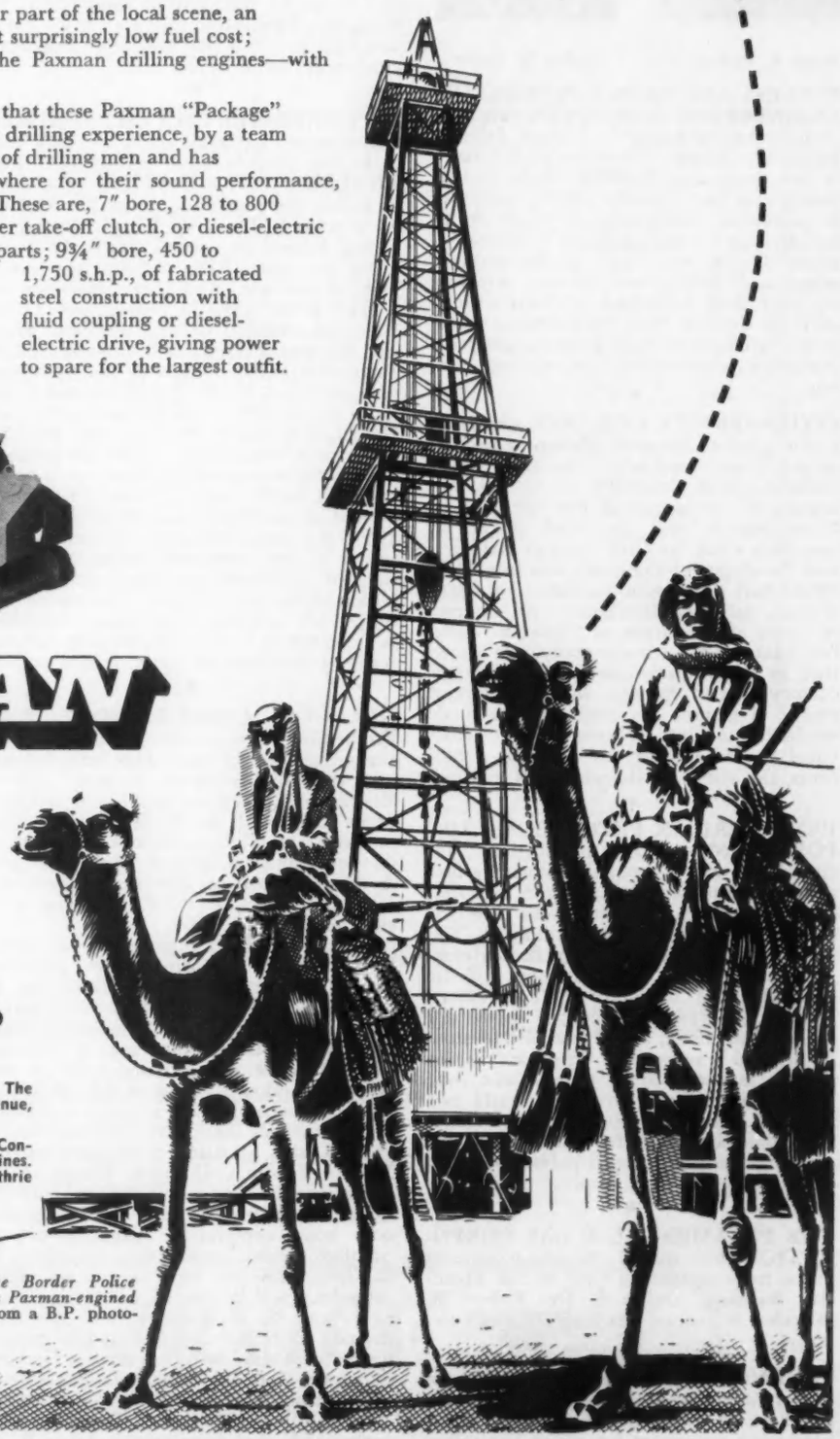
IN MARACAIBO AND CARACAS, Petroleum Industry Consultants C.A., carry full stocks of spares for Paxman engines. IN NORTH BORNEO a similar service is provided by Guthrie & Co. Ltd. of Seria.



BASRAH — Members of the Border Police mounted on camels, guard a Paxman-engined B.P.C. rig at Rumaila.—(From a B.P. photograph.)

J.38

Companies in the News

James A. Perkins, Jr.

Julian W. Quinn

PERKINS AND QUINN PETROLEUM ENGINEERING CONSULTANTS has been formed by **James A. Perkins, Jr.**, and **Julian W. Quinn.** Offices are at 701 Bank of the Southwest Building. Both Perkins and Quinn have had 23 years' experience in petroleum engineering with the Houston division of the Gulf Oil Corporation where Quinn was chief of the reserves group and Perkins was division reservoir engineer. Both have had extensive experience in drilling, well completion, workovers, production management, property evaluation, reserves and reservoir engineering.

•

CITIES SERVICE COMPANY dedicated a new product research laboratory located on a 100-acre tract beside the New Jersey Turnpike near Cranbury, N. J. The laboratory is the largest of five operated by Cities Service and the third placed in operation since the Cities Service Research and Development Company was formed in 1948. **Burl S. Watson**, president of Cities Service, said the laboratory will operate in three major areas of research—fuels, lubricants and nuclear energy. He noted that in the radiation section of the laboratory Cities Service has the largest source of gamma ray emission ever made available to industry—energized cobalt equal in radioactivity to two and a half times the entire world supply of radium.

•

PAN AMERICAN PETROLEUM CORPORATION'S employe publication "Horizons" has won its second consecutive first place international award for editorial excellence in its class from the International Council of Industrial Editors. The award was presented to **Allan B. Carleton**, "Horizons" editor, who accepted for the magazine and its other staff members, **William J. Nash**, publications supervisor for Pan American, and **Byron G. Houston**, photographic supervisor. "Horizons" is one of the few magazines to win out over competitors throughout the world two years in a row. Its category covers magazines published both for employes of the company and the general public, but with primary emphasis on employe readership.

•

THE PYRAMID OIL & GAS CORPORATION has moved its Mid-Continent office from Oklahoma City to 726 Meadows Building, Dallas 6. **Dr. Robert R. Wheeler** is general manager of the company.

•

PRODUCING PROPERTIES, INC., of Dallas, announced the completion of the purchase of two separate groups of oil producing properties for which the sellers will receive a total consideration of $1,099,840. These properties consist of an undivided interest in 49 wells located in the Slocum field, Anderson County, Texas, and various royalty interests located in the Sacroc Unit, Scurry County, Texas. The Slocum Properties were purchased jointly from **John Pace** of Houston, and **J. Robert Phillips, Jr., Jack D. Orr**, and **F. C. Gaines, Jr.**, of Dallas. The sellers received for their interest $895,000. The Sacroc Royalty was purchased from **E. E. Fogelson** of Dallas for $63,340 cash subject to an oil payment in the amount of $141,500. This latter purchase is in addition to a previous purchase from Fogelson announced last May 20.

•

REITER FOSTER OIL CORPORATION has acquired for $1,675,000, in stock and cash, the properties of **ADVANCE PETROLEUM CORPORATION** of Dallas, including the producing properties of **Carl J. Westlund, Emil V. Hegyi**, president, Reiter Foster announced. With the combined purchase, RFO acquires the assets and oil and gas producing properties on 27,415 gross acres in Texas and Oklahoma, in addition to four complete drilling rigs and a 34 percent interest in 640 acres of uranium claims in the Ambrosia area of Grant, N. M. The Westlund properties are located in the oil pools of Ector, Gaines, Glasscock, Reagan and Sterling counties of West Texas, while the producing properties owned by Advance are located in north central Texas, Oklahoma, as well as in West Texas. As of March 1, 1957, the total estimated oil and gas reserves of the Advance-Westlund acquisition are 1,950,000 barrels of oil and two billion cubic feet of gas. The estimated future net revenue from these properties is expected to be $4,400,000 after operating and development costs, Hegyi said.

•

GULF OIL CORPORATION'S Tulsa Production division has announced the realignment of its operations into districts and the elimination of its zone offices. District offices will be established at Oklahoma City, with **E. W. Brake** as district manager; at Wichita, with **A. L. Latta** as district manager; and at Evansville with **A. C. Godbold** as district manager; all reporting direct to **N. C. Simpson**, division manager in Tulsa.

Brake, as district manager of the Oklahoma district, will direct the operations in Oklahoma and northern Arkansas. **P. A. Weirich**, presently division chief geologist, is appointed district exploration manager; **W. H. Duley**, now zone production superintendent in Ardmore, will be district production manager; and **L. B. Wade**, who has been division services supervisor in Tulsa, will be district services manager. Latta, as district manager of the Kansas district, will have charge of its operations in Kansas, Nebraska and the Oklahoma Panhandle. **K. W. Bumgarner**, now zone exploration manager, is appointed district exploration manager; **L. L. Gray**, presently zone production superintendent, will be district production manager; and **M. B. Moseley**, who has been division clerk of the Production department in Tulsa, will be district services manager. Godbold, as district manager of the Evansville district, will direct operations in Illinois, Indiana, Michigan, Kentucky and the Appalachian area. **F. L. Carpenter**, currently zone production superintendent, will be district production manager; **O. P. Gilbert**, now zone exploration manager, is appointed district exploration manager; and **H. M. Holstein**, presently section supervisor in the Tulsa office, will be district services manager.

•

THE TEXAS COMPANY announced that they will build a fully-equipped nuclear radiation laboratory at the Texaco Research Center in Beacon, N. Y. **Frederic H. Holmes**, vice president in charge of Texaco's Research and Technical department said that construction will start immediately and is expected to be completed by April, 1958. The laboratory will be unique in that it will be equipped with three different radiation sources. It will house a 6-million-volt linear accelerator, the first of its kind in the petroleum industry; a 3-million-volt Van de Graaff generator, and a 35,000 curie cobalt 60 source of gamma radiation.

•

HERITAGE PETROLEUM CORPORATION has established offices in the Mercantile Securities Building, Dallas. This company was organized for the purpose of purchasing oil and gas production throughout the southwest. The financing of the corporation was arranged by Kuhn, Loeb and Company, international bankers of New York. The principal officers in the firm are **Clinton Davidson** and **C. C. Harter, Jr.**, president. Harter was formerly with DeGolyer & MacNaughton specializing in the evaluation of mineral properties, later as a partner in Bradley, Crichton and Associates, and subsequently became executive vice president of Oil & Gas Property Management, Inc., prior to becoming president of Heritage.

•

TEKOIL CORPORATION, independent oil and gas producer specializing in secondary recovery, will direct all production operations from Oklahoma City beginning September 1, as the result of office and personnel transfers announced in Dallas recently. Tekoil executive offices will remain in Dallas, and its regional operations office at Midland, Texas, will be maintained. Included in the move from the corporation's home offices at Robinson, Ill., will be the headquarters of **R. E. McCulloch**, superintendent of operations for three midwestern states, and the land evaluation office headed by **Murray E. Guyer.** Also transferring to new headquarters in Oklahoma City is **Robert E. Shaw**, Tekoil secretary-treasurer. The move will affect all of the company's accounting personnel. Its Oklahoma operations were expanded this summer with the purchase of 34 producing oil wells in Lincoln County's Sunflower pool, where the company is currently planning to institute a test of the miscible phase displacement theory.

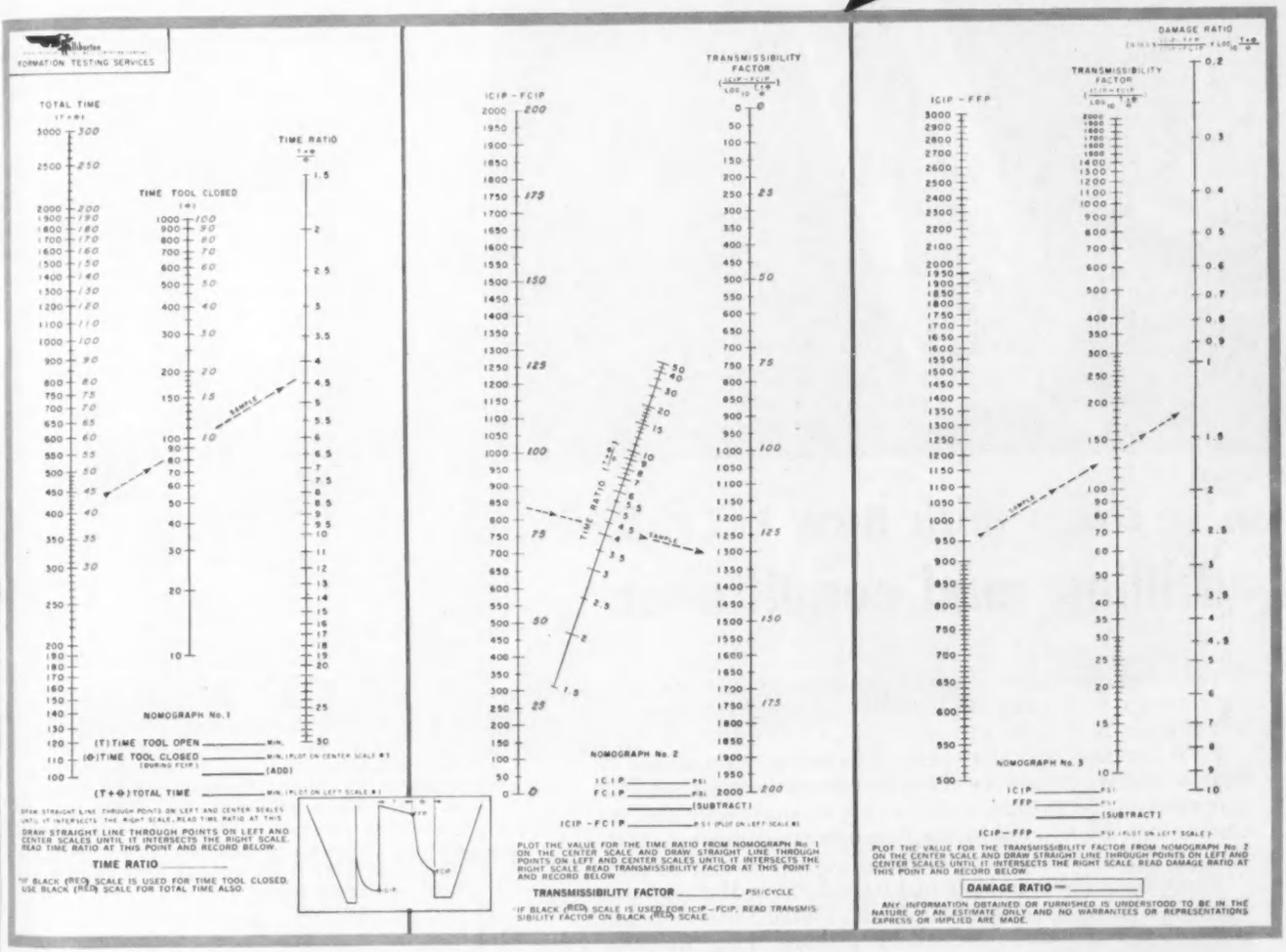
•

SINCLAIR OIL & GAS COMPANY has transferred its Property Acquisition department from Houston to Tulsa, and **Connie L. Wilson** has been named manager of the department. Wilson, assistant division manager of Sinclair's Fort Worth division since May, 1956, succeeds **J. B. Kennedy**, who was elected executive vice-president for operations of Sinclair and transferred from Houston to company headquarters in Tulsa. Transferred to Tulsa with the Property Acquisition department were **H. M. Evans**, staff valuation engineer, **Eugene C. Roberts**, senior valuation engineer, and **Rex A. Sackett**, chief clerk.

helps you to better well evaluation...

DAMAGE RATIO COMPUTED FROM DUAL CIP READINGS

and these three nomographs:



Although damage ratio must necessarily be an approximation, the data gained may result in a different evaluation of the tested interval and warrant a change in the drilling schedule or completion procedure for greater productivity.

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faced with unusual problems?

solve them with **new CYPAN® drilling mud conditioner**

CYPAN, a high-molecular weight, acrylic-type polymer, is showing superior fluid loss control performance in water-base and oil-emulsion type drilling fluids.

Field use and laboratory tests demonstrate its stability at high temperatures and in the presence of contaminants. It maintains its effectiveness under widely varying conditions, including high dilution with water. It possesses outstanding resistance to fermentation, rarely requires preservative treatment.

CYPAN is available in 50-pound bags through Magnet Cove Barium Corporation, distributors in the United States and Canada (and in California, also available through Macco Corporation). Ask these drilling mud service companies for information on how CYPAN can help solve your drilling mud problems.

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New Books

WEST TEXAS OIL LIFTING SHORT COURSE ASSOCIATION TECHNICAL PAPERS, Department of Petroleum Engineering, Texas Technological College, Lubbock, Texas, $5.00.

Technical papers presented last April at the Fourth Annual West Texas Oil Lifting Short Course at Lubbock have been published in a 230-page book by Texas Technological College, which sponsored the course. The book contains more than 40 illustrated papers and a panel discussion.

•

ECONOMIC CONCENTRATION AND THE MONOPOLY PROBLEM, Edward S. Mason.

Professor Mason's book is a timely one for the oil industry with the investigations and controversies over price going on. The book is divided into four parts: 1. The large firm and the structure of industrial markets; 2. Wage-price problems; 3. Raw materials, security and economic growth, and 4. Antitrust policy.

His approach provides a bright avenue for defense against critics of the oil industry who too readily jump from questionable evidence on size and "price leadership" to unwarranted conclusions of monopoly.

•

ROCKY MOUNTAIN OIL AND GAS OPERATIONS FOR 1956, Petroleum Information Offices in Denver, Casper, Billings, Bismarck and Los Angeles, $10.

A complete summary of 1956 oil and gas activity is contained in this book, twenty-seventh such volume published by the Denver oil information service firm.

Statistics show that new records were set in almost every phase of the oil industry in the Rockies in 1956. During the year, 4956 wells were completed in Rocky Mountain states. By comparison, in 1950 only 1005 wells were completed.

Petroleum Information's review summarizes regional oil economics, techniques, production, markets, exploration and leasing in 85 pages of text and illustration. The volume also contains a summary of each discovery made in the region, gives a list of all Rocky Mountain units, lists all the region's refineries, lists 1956 and cumulative production of each field in the region, and lists location total depth and status of every well completed in the Rockies during the year.

•

CALIFORNIA OIL FIELDS, Department of Natural Resources, Division of Oil and Gas, San Francisco 2.

The forty-second annual report is a summary of operations of the California oil fields for the months of January through June, 1956. The articles contained present the results of observations of engineers of the Division of Oil and Gas.

Ten maps are included in the study.

•

WE DRILLED SPINDLETOP! Spindletop Foundation for Advancement of Medical Research, Offices of Claud Hamill, 21st Floor, First City National Bank Building, Houston, $1.

Spindletop Foundation for Advancement of Medical Research, a charitable organization to further research in muscular dys-

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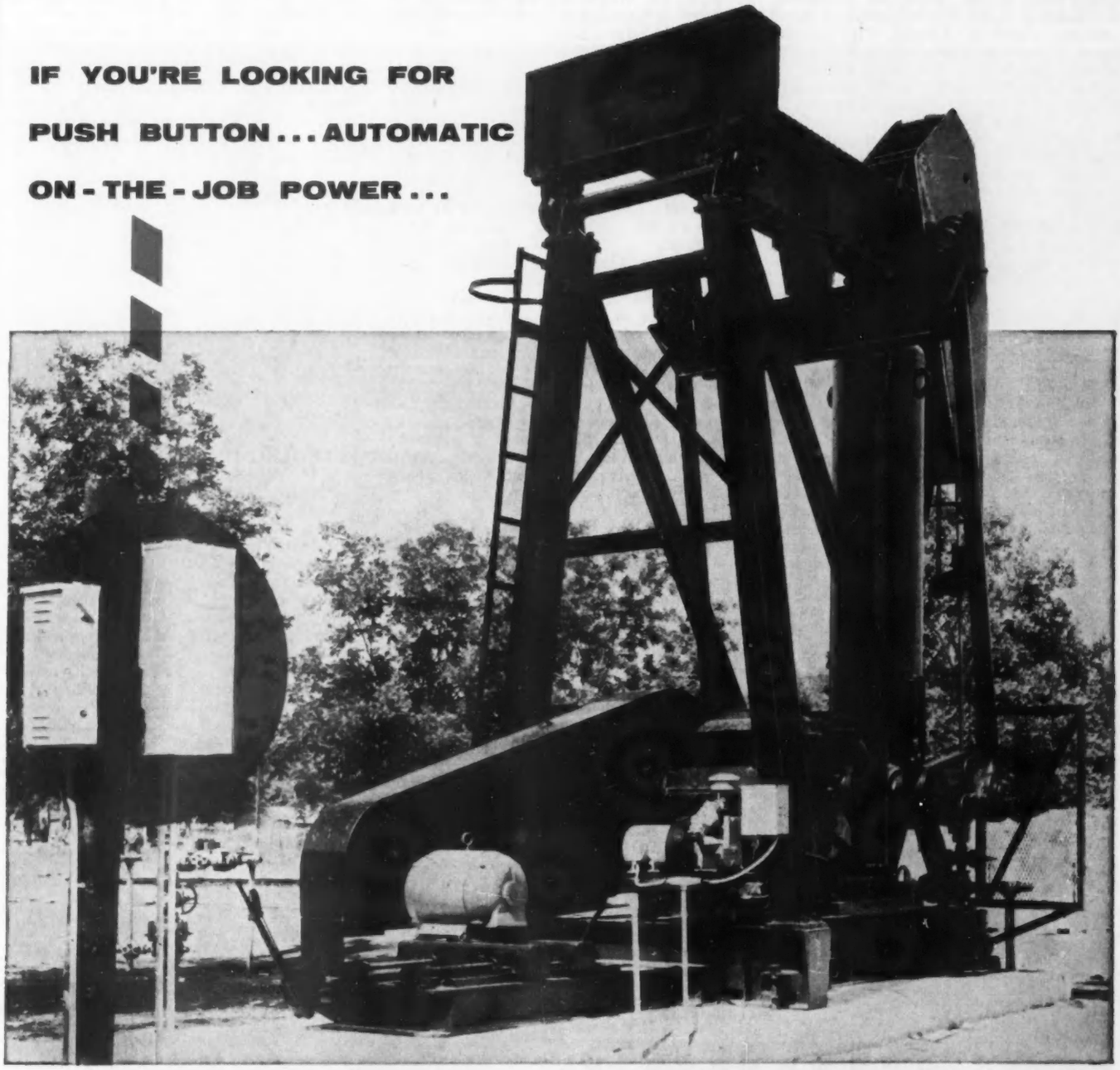
PUSH BUTTON... AUTOMATIC

ON-THE-JOB POWER...



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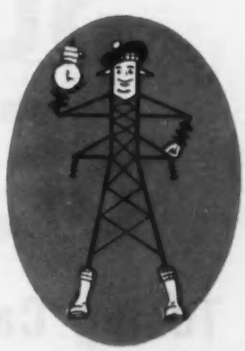

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trophy and cancer, has been established in Houston under the trusteeship of oil operator Claud B. Hamill. The foundation will receive all proceeds from the sale of the recently-published book. Money received will be turned over to medical science for study of the two diseases.

"We Drilled Spindletop!" was written by Curtis G. Hamill, father of Claud Hamill and last living person who was connected in any way with the drilling of the gusher that brought in the modern oil industry.

The elder Hamill, a member of the drilling crew, has set down his recollections of the event in his own words, in a narrative that runs to 35 pages. There are 17 pages of illustrations. The book has been called a significant contribution to the history of the oil industry, revealing several new facts about the Lucas gusher.

•

IRA RINEHART'S 1957 YEARBOOK, Rinehart Oil News Company, P. O. Box 1208, Dallas, $20 to subscribers, $25 to non-subscribers.

This annual double-volume statistical publication contains a complete 29-area coverage of 1956's discoveries, major extensions, and significant wildcat failures—supplemented with state, field and area maps, plus summary information on regional trends. The book is conveniently indexed.

•

FIRST INTERNATIONAL WILLISTON BASIN SYMPOSIUM, Conrad Publishing Co., Book Division, Bismark, N. D., $7.50.

The 200-page volume contains 28 papers and abstracts and hundreds of illustrations. Among the Williston Basin oil areas reviewed in geological detail are Poplar, Midale, Virden, Roselea, Alida, Cedar Creek, Bowes, Nesson Anticline and Bottineau County.

The papers were originally presented by their authors in Bismarck, N. D., the first International Symposium which was sponsored jointly by the North Dakota Geological Society and the Saskatchewan Geological Society.

•

1956 OIL AND GAS DEVELOPMENTS IN OHIO, George G. Shearrow, Ohio Division of Geological Survey, Orton Hall, The Ohio State University, Columbus 10, Ohio, Free.

This is one of a series of annual reports on statistics of the oil and gas industry of Ohio. It contains well drilling and production statistics during the year 1956. A total of 1245 new wells in 56 counties were completed in 1956. Of these, 878 were successful, and 367 were dry, an average of 70.5 percent successes.

The summary of statistics is given by producing horizon and by county. A list of well sample cuttings received during the year is also given.

•

PELECYPODA FROM THE TYPE LOCALITY OF THE STONE CITY BED (MIDDLE EOCENE) OF TEXAS, By H. B. Stenzel, E. K. Krause and J. T. Twining, Bureau of Economic Geology, The University of Texas, Austin, $3.75.

A detailed section is given of the Stone City beds at Stone City Bluff on the Brazos River in Burleson County. Eighteen fossil pelecypod species are described formally and compared with congeneric Eocene species of the Gulf and Atlantic Coastal Plain.

Three new genera and one new subgenus are proposed, and a new sub-family is established; several synonyms were discovered in the course of the study. Stratigraphic horizon and location of the type locality of each species described were in many instances determined from field investigations done by Stenzel.

•

PETROLEUM PRODUCTION TECHNOLOGY, Texas Engineering Experiment Station, Texas A & M College, College Station, Texas.

This paper-back book contains the proceedings of the conference of the American Institute of Mining, Metallurgical and Petroleum Engineers held January 9-10, 1956, at College Station. The theory and practice known to various companies and agencies and discussed herein, aid in certain types of geologic and operating conditions.

•

PETROLEUM AND ITS PRODUCTS, J. H. Van der Have and C. G. Verver, Pitman Publishing Corporation, New York.

This book reviews the whole field of petroleum production and refining, describing the exploration and drilling for petroleum, the composition of the various kinds of crude oil, the manufacture of the numerous derivatives that are made from it and the properties that these products should possess.

Many of the technical details which discourage readers of other oil subject books are eliminated.

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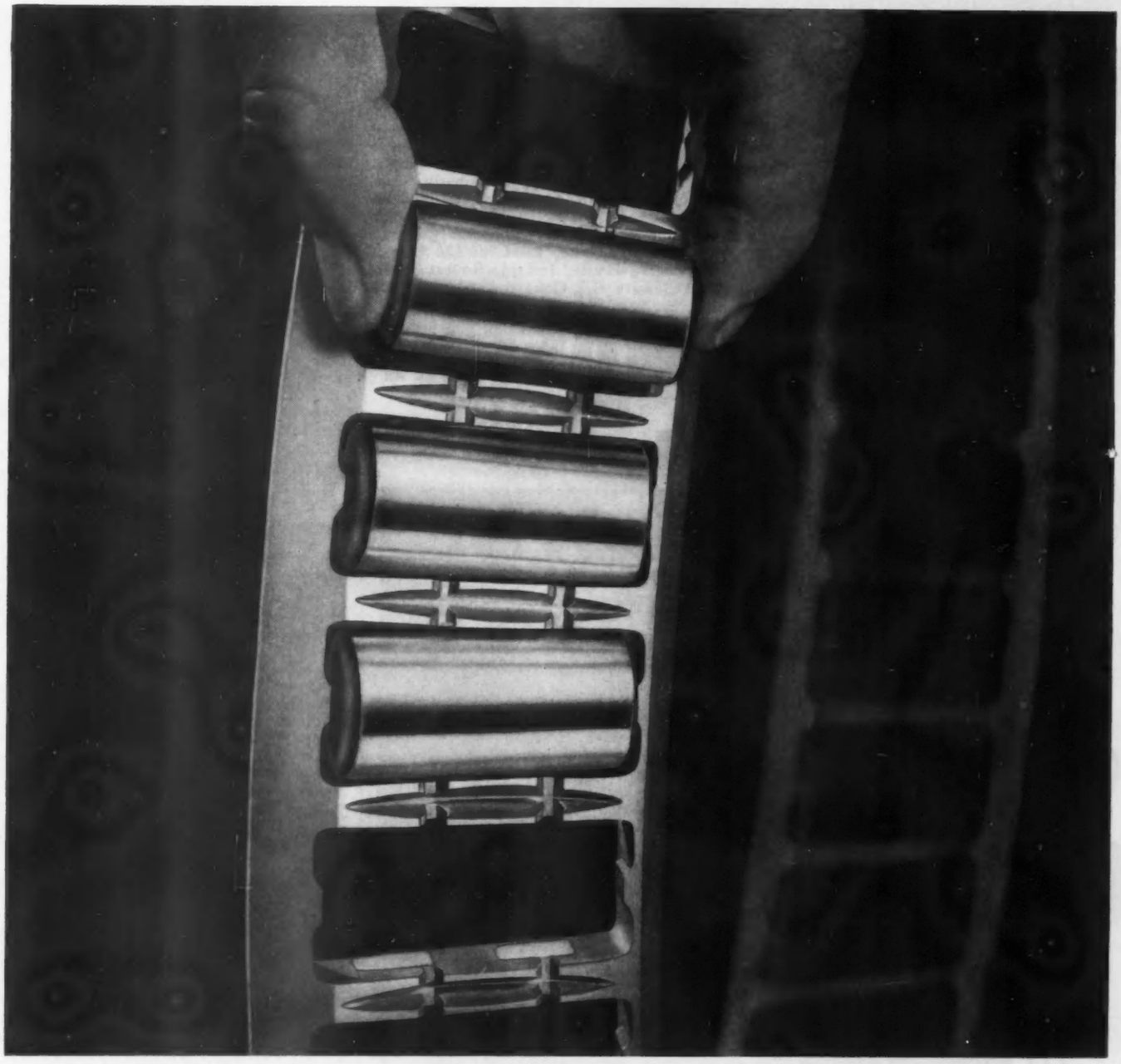

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What's Happening

AMONG INDUSTRY ASSOCIATIONS

Eastern API Production Appoints New Officers

The appointment of new officers and the presentation of 12 technical papers, one which dealt with the use of air photographs to find new oil fields, closed the annual Eastern district meeting of the American Petroleum Institute Division of Production. More than 600 oil men from Pennsylvania, New York, West Virginia, Kentucky, Ohio, Illinois and Indiana registered during the three-day meeting.

New district officers named were: Eastern district chairman—Lysle R. Kirk, Ohio Fuel Gas Company, Columbus, Ohio; Vice Chairmen—R. C. Curtis, Carter Oil Company, Mattoon, Ill.; L. T. Evans, East Ohio Oil Company, North Canton, Ohio; Millard Flood, the Ohio Oil Company, Terre Haute, Ind.; J. Robert Hornor, Delaware Gas Company, Clarksburg, W. Va.; R. J. Murdy, New York State Natural Gas Company, Pittsburgh, Penn.; H. J. Magner, Delta Drilling Company, Pittsburgh, Penn.; Wendell Moore, Columbian Carbon Company, Charleston, W. Va.; Quentin Wood, Quaker State Refining Company, Bradford, Penn.; Dean Russell, Gordon Drilling Company, Mt. Pleasant, Mich.

Also named to official positions were Harry T. Heuple, Manufacturers Light & Heat Company, Pittsburgh, Penn., as district secretary-treasurer, and Douglas Rogers, Jr., South Penn Oil Company, Bradford, Penn., as chairman of the district advisory committee.

The paper dealing with air photography, technically entitled "Airphotos in the Oil and Gas Industry" was presented by Theodore A. Cheney, The Air Force Center, Cornell University, Ithaca, N. Y.

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A guide mounted vertically under the rotary head, and a short distance above the ground, holds the first length of drill pipe, and the bit, vertically and prevents the turning bit from wandering at the commencement of the hole. As drilling progresses the guide serves to reduce whip in the drill string and so assists in maintaining the drilling of a straight hole. Send for illustrated bulletin.

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Dickey Succeeds Brandt As Tulsa Geological Head

Dr. Parke A. Dickey, head of the geological research section of The Carter Oil Co., was named president of the Tulsa Geological Society for the 1957-1958 year. He succeeds Ralph A. (Jack) Brandt, divisional research geologist of the Atlantic Refining Co.

Augustus Goldstein, senior geologist of the Pan American Petroleum Corp., was elected first vice-president, succeeding Henry J. Schaetti, research geologist, Carter. Norman S. Morrisey, drilling and development editor of "The Oil and Gas Journal," was named second vice-president, succeeding his associate, Dr. Frank J. Gardner, exploration editor of the Journal.

James W. Snider, division geologist of the Amerada Petroleum Corp., is the new secretary, succeeding Charles H. Glidden, Union Oil Co. of California. G. Wilbur Haynes, senior geologist, Pan American, was elected new treasurer. He replaces David E. Reed, Kewanee Oil Co.

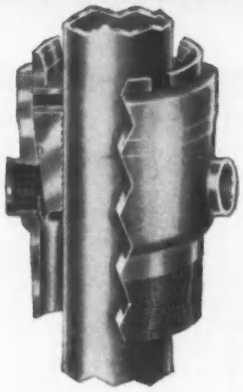
Robert H. Arndt, assistant professor of geology, University of Tulsa, is new editor, succeeding Philip C. Scruton, staff geologist, Pan American. S. E. Frezon, head of the Fuels Branch office of U. S. Geological Survey, is new TGS business manager, and replaces Bill O. Andress, chief geologist of Blackwell Oil and Gas Co.

The three new council members are Edmund T. Benson, Service Pipe Line Co., Donald E. Hanson, Sinclair Oil and Gas Co., and Donald L. Norling, independent. They succeed Edmund T. Benson, Service Pipe Line, John J. Rupnick, consulting geophysicist, and R. H. Swanson, Sinclair.

The newly elected officers will be installed in October.

So. California Engineers Plan Annual Fall Meeting

The Southern California section of petroleum engineers of AIME will hold its annual fall meeting in Los Angeles, October 17 and 18, according to D. G. Kingman, chairman of the group. The two-day session will be held in the Biltmore Hotel and will be co-sponsored by the San Joaquin Valley section and the



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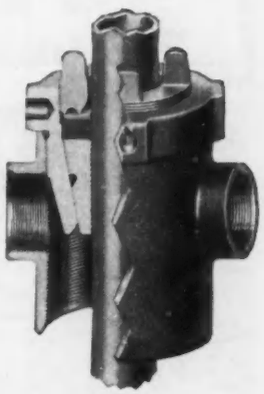
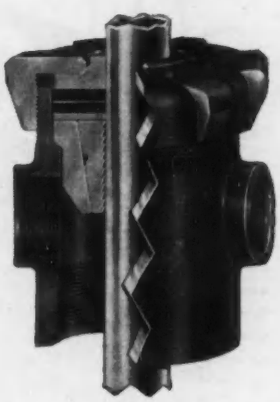
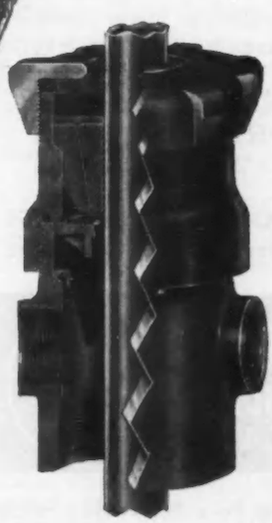


Type R

The Larkin Type R Tubing Head is a conversion from the Type SR Head. This ease of conversion makes it possible to use the same stripper adapter and Neoprene stripper when working on any well equipped with a Larkin Tubing Head.





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The Larkin Type SR Tubing Head is a slip suspension head, equipped with a Neoprene Stripper which serves as a blow-out preventer and oil saver while tubing is being pulled or run. It is very suitable where higher pressures might be encountered.

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California Coastal sub-section. Chairman of this year's meeting is T. A. Atkinson, Douglas Oil Company and the program chairmen are C. F. Gallagher of Schlumberger Well Surveying Corp., and W. E. Bourne of Amerada Petroleum Corp.

The other chairmen for this year's meeting are arrangements, Ray Elner of Kobe, Inc.; exhibits, L. W. Chasteen of Union Oil Company; and dinner dance, Tom Morton of Halliburton Oil Well Cementing Co.

Jones and Chipman to Head Penn Crude Oil Association

J. P. Jones of Bradford, Penn., was elected as president of the Pennsylvania Grade Crude Oil Association at the meeting of the Association Board of Directors following the annual Penn Grade meeting in Pittsburgh. Jones will continue as director of production for the association. He succeeds Charles A. Chipman of Bolivar, N. Y., deceased.

Glenn E. Scott, vice president, Wolf's Head Oil Refining Company, Oil City, Penn., was elected assistant treasurer.

The following officers were re-elected recently: George J. Hanks, president of South Penn Oil Company, Oil City, first vice president; A. C. Simmons, Simmons Oil Company, Bradford, second vice president; Fayette B. Dow, Washington, D. C., vice president and general counsel; and the following, all of Oil City:

Samuel Messer, Quaker State Oil Refining Corporation, treasurer; C. L. Suhr, South Penn Oil Company, and C. G. Johnson of Quaker State Oil Refining Corporation, assistant treasurers; and W. C. Wenzel, executive manager.

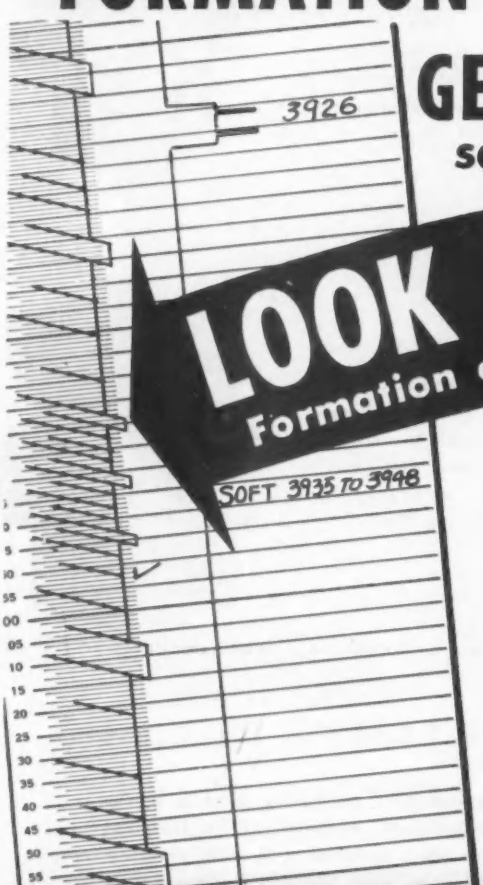
Regional AAPG to Begin Annual Meeting in October

The 1957 annual meeting of the Mid-Continent section of the American Association of Petroleum Geologists will be held on the last day of October and the first day of November this year in Tulsa at the Mayo Hotel. However, meetings, technical discussions, and exhibits will be located at the Educational building on the Tulsa State Fairgrounds.

Reservations for exhibit space in the Educational building are now being taken. Accommodations for outside exhibits of any size are also available on paved grounds adjacent to the Educational building.

An attendance of 1500 geologists is expected. Registered attendance at Oklahoma City last year was over 1200.

FORMATION CHANGES?



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MONTANA: Glendive, Billings **NEW MEXICO:** Farmington, Lovington
COLORADO: Grand Junction, Sterling **ALBERTA:** Edmonton

Farmington, N. M., Drillers Organize AAODC Chapter

Drilling contractors of the Four Corners and San Juan Basin have organized a new chapter of the American Association of Oilwell Drilling Contractors.

J. M. Riddle, Moran Bros., Inc., was named chairman, and Robert E. Jackson, Empire States Drilling Corp., was elected vice chairman. Both are of Farmington, N. M. A chapter secretary will be selected later.

To be known as the Farmington Regional chapter, the new AAODC group becomes the 19th in the Association's local chapter organization. Sixteen oil well drilling contractors attended the initial meeting of the new chapter.

Brad Mills, Dallas, AAODC executive vice president, met with the new chapter to explain the relationship between the national and regional groups.

Barrett Succeeds Curry As RMOGA President

A. F. Barrett, manager of Rocky Mountain operations at Billings, Mont., for Mobil Producing Co., is the new president of the Rocky Mountain Oil and Gas Association, succeeding W. H. Curry, independent, of Casper, Wyo., having been chosen at the twelveth annual convention held in Denver.

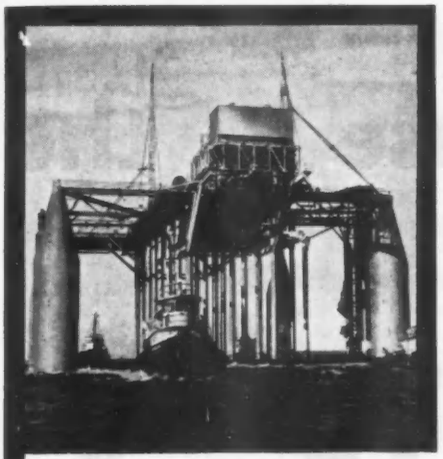
Other officers include: H. A. (Dave) True, Jr., Casper, vice president for Wyoming; Warren J. Hancock, Billings, vice president for Montana; Robert E. McMillen, Sidney, vice president for Nebraska; F. H. Gower, Denver, vice president for Colorado; Bruce Anderson, Casper, treasurer.

AAODC Directors Vote $10,000 Education Grants

Education grants totaling $10,000 were approved by the American Association of Oilwell Drilling Contractors board of directors.

To be administered by the AAODC Education and Training Committee, the appropriation includes $1000 to be added to previously allocated funds for financing the writing of a new college-level drilling textbook.

Committee Chairman H. W. Davidson, Midland, Texas, said the total grant of $3600 will be made available this summer to Professors F. W. Cole and A. W. McCray of the University of Oklahoma to



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assist them in completing preparation of the technical book.

The AAODC board voted allocation of $5000 to continuation of the Association's annual grant-in-aid to the Petroleum Extension Service of The University of Texas. The remaining funds will be used by the Education and Training committee in sponsoring other activities, such as the training films and the AAODC School of Drilling Technology in Odessa, Texas.

San Joaquin Section Is 53rd Organized by NACE

The fifty-third local section of the National Association of Corrosion Engineers was organized at Bakersfield, Calif., recently. The Association actually is international, with five sections in Canada.

U. S. Chamber Names AAODC Head to Board

Jack H. Abernathy, president of the American Association of Oilwell Drilling Contractors, has been elected director-at-large of the U. S. Chamber of Commerce.

Abernathy is also vice president of Big Chief Drilling Company, Oklahoma City. He will serve on the Chamber's Natural Resources Committee. He is one of the two oil industry representatives on the 58-man board.

South Texas Geophysicists Elect 1957-1958 Officers

The Geophysical Society of South Texas, San Antonio, announced the selection of new officers for the 1957-58 term. Elected president was William R. Gray, consulting geologist and geophysicist.

Harry Mayne, research engineer with Petty Geophysical Engineering Co. was elected vice president, and Jack W. E. Edmonson, geophysicist with P. E. Narvarte was elected secretary-treasurer. The Society is the South Texas section of the Society of Exploration Geophysicists.

Cook of Standard Oil Co. Is Eastern AAPG President

Carroll E. Cook of Standard Oil Company (New Jersey) has been elected president of the Eastern section, American Association of Petroleum Geologists in New York.

Other new Eastern section AAPG officers elected for 1957-58 are Charles H. Dresbach, Gulf Oil Corporation, vice president; H. D. Klemme, American Overseas Petroleum Ltd., secretary; and O. W. Nine, Arabian American Oil Company, treasurer.

New Officers Are Elected For Illinois O & G Group

Newly elected officers of the Illinois Oil & Gas Association for 1957 are Thomas N. Duncan of N. V. Duncan Drilling Company, president; O. F. Beaty of Magnolia Petroleum Company, first vice president; Howard L. Brockman, Calvert Drilling, Inc., second vice president; M. H. Guess, Shell Oil Company, third vice president.

Also C. Richard Collins, Collins Bros. Oil Company, secretary; Homer Rutherford, Rutherford & Co., treasurer; and Charles J. Pardee, executive secretary.

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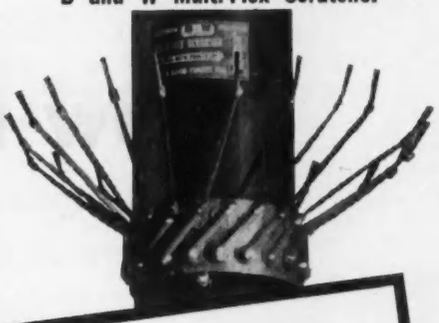

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What's Happening

AMONG SERVICE AND SUPPLY MEN

Charles T. Reichert

Harvard C. Tait

James M. Davies

Galen L. Lindner

The National Supply Company has announced four personnel changes in the Export division. **Charles T. Reichert** has been appointed manager of the London office. He replaces **R. B. Rogers** who has retired after more than 35 years with the company. **Howard C. Tait** has been appointed area manager for Venezuela, Mexico and Alaska. **Galen L. Lindner** has been appointed Export division engineer, replacing Tait. **James M. Davies** has been appointed district manager for eastern Venezuela with headquarters at Anaco. Reichert started with the company in 1916. After several years in various sales and engineering assignments, he was made sales manager of the California division in 1947. Tait joined National Supply in 1948. He was appointed supervisor of personnel training in 1952 and was transferred to the Export division as division engineer in 1955. Lindner joined National in 1949. He later did sales work in the Kansas and Oklahoma oil fields and in 1952 was transferred to the Export division, where he has since filled several Venezuelan assignments. Davies started with the company in 1935 at the Mountain View, Calif., store. Various field sales assignments at Avenal, Kettleman Hills and Coalinga were followed by his appointment as manager of the San Joaquin Valley district in California early this year.

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Baroid Division, National Lead Company, has announced several new promotions in area and district offices. In Canada, **J. H. V. Matthews,** manager of Drilling Mud Products, Ltd., assumes the position of assistant area manager, Baroid of Canada, Ltd. He replaces **Ray R. Morris** who has been appointed administrative assistant, Drilling Mud department, Houston general office. **R. E. Nichols** is the newly appointed area engineer with headquarters in Calgary, Alberta. In the Louisiana Gulf Coast area, **Fred M. Hill, Jr.,** former district superintendent, is the new administrative assistant, Drilling Mud department, New Orleans office, and he was replaced as district superintendent of southeast Louisiana by **Damon Bankston,** formerly sales representative in New Orleans. **John C. Luck, Jr.,** area engineer of Baroid of Canada, Ltd., has been transferred to New Orleans as sales representative. **R. T. Sutton,** district superintendent in the Pacific Coast area, is now district superintendent of north Louisiana and Arkansas. **Ted H. Hudson,** service engineer in the Rocky Mountain area, is the newly appointed store manager at Worland, Wyo., replacing **R. E. Nichols.** In the Pacific Coast area, **Joseph P. Byrne,** sales representative, has taken over duties as district superintendent in northern California and will operate out of Bakersfield, Calif.

•

Schlumberger Well Surveying Corporation has appointed nine division and district managers and sales engineers. **W. J. Bowen** has been promoted to the position of manager of the Northeast division at Evansville, Ind. Prior to his promotion, Bowen was assistant manager of the Louisiana Coast division at Lafayette, La. New district managers are **T. C. Nichols** at New Iberia, La.; **G. F. Chambliss** at Cortez, Colo.; **George Broussard** at Franklin, La., and **J. M. Price** at Ardmore, Okla. New division sales engineer for the Louisiana Coast division with headquarters in Lafayette is **A. Perez. D. W. Stinger** is now senior sales engineer at Duncan, Okla. **W. L. Boeken** has been appointed sales engineer for the Shawnee, Okla. district, and **F. M. Mullins** assumes the same position at New Iberia, La.

•

Charles H. Swartz and **Jack L. Mershon** were elected vice presidents of **Southwest Industries, Inc.** Swartz has been with Southwest for two years in sales engineer work. Previously, he was associated with the Gulf Oil Corporation in the Gas department. Mershon will continue to manage the Tulsa office. He has been with Southwest for two years. Prior to that he was associated with the Kellogg Company as a construction engineer, worked for a time in the Philippines. His last assignment before joining Southwest was in refinery construction work with Refinery Engineering of Tulsa.

Jack L. Mershon

•

The National Supply Company has announced the following personnel changes in its California division. **Jess D. McClendon** has been appointed division sales manager, with headquarters at Torrance. He succeeds **Charles T. Reichert,** now in charge of the London office of the Export division. **John R. Mefford** replaces McClendon as division tubular manager at Los Angeles. **Charles A. Chandler** has been appointed district manager of both the Southern and Northern districts, with headquarters at Torrance.

•

James J. Gilligan has been appointed executive assistant to the general manager of the **Axelson Manufacturing Company,** Los Angeles, division of U. S. Industries, Inc. Gilligan was formerly associated as a consultant with the firms of Booz, Allen and Hamilton and Day and Zimmerman, Inc. Prior to this he was controller for the Dennis Mitchell Industries.

James J. Gilligan

In his new position Gilligan will be responsible for management development, organization planning and the financial management of Axelson.

•

James Bere

James Beré has been named president of **Axelson Manufacturing Company. Beré** joined Clearing Machine Corporation in 1946 and later became general manager of its Hamilton, Ohio, plant. Clearing was acquired by U. S. Industries, Inc., in 1954. In 1956 Beré was transferred to the Axelson division, serving as general manager until the present time.

•

Gene Poore was appointed district manager for the **Cardwell Manufacturing Company** in the tri-state area including Indiana, Illinois and Kentucky. He was formerly associated with American Manufacturing Company of Texas as a sales representative. He has also had extensive experience in the oil field supply business.

•

Grover Kilgore, Halliburton Oil Well Cementing Co., Duncan, Okla., vice president for sales and advertising, was appointed to the **National Petroleum Council,** which advises the government on matters pertaining to oil production, refining and distribution. Kilgore will represent the Petroleum Equipment Suppliers Association of which he is national president.

•

Igor Sikorsky retired in May, 1957, as engineering manager of Sikorsky division of **United Aircraft Corporation** at the age of 68. However, he continues as a consultant to the division. A pioneer in many

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*Swinging Compound**

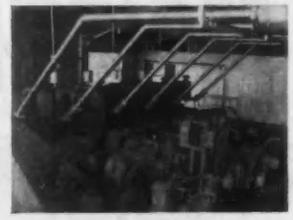
rig drive for any engine

In 10 years of world-wide service, the Mid-Continent *Swinging Compound has proved its versatility and superiority for practical multiple power assemblies. The Mid-Continent Rig Drive is readily adaptable to most engine-drawworks combinations. Its exclusive Swinging Compounds speed up moves and reduce rig-up time. The Mid-Continent rig drive has a field-proved reputation for long service without overhaul. More than 100 of these outstanding rig drives have been specified by oil companies and drilling contractors for their world-wide drilling operations. Whatever your rig drive requirements, Mid-Continent's engineering staff is ready to assist you. Call your nearest Mid-Continent representative today.**

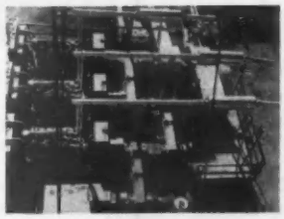
Since 1947, more than 100 Mid-Continent Rig Drives have been specified for drilling world-wide.

1947

1948



1951



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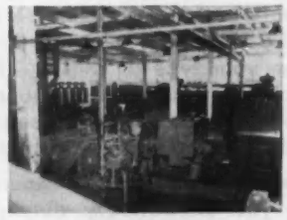

1955

1957

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Export Division: 45 Rockefeller Plaza, New York 20, N. Y. CABLE ADDRESS: MIDCUMPORT NYK

MID-CONTINENT Supply Company

MID-CONTINENT BLDG. FORT WORTH, TEXAS

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THE WORLD'S LARGEST INDEPENDENT OIL FIELD SUPPLY COMPANY

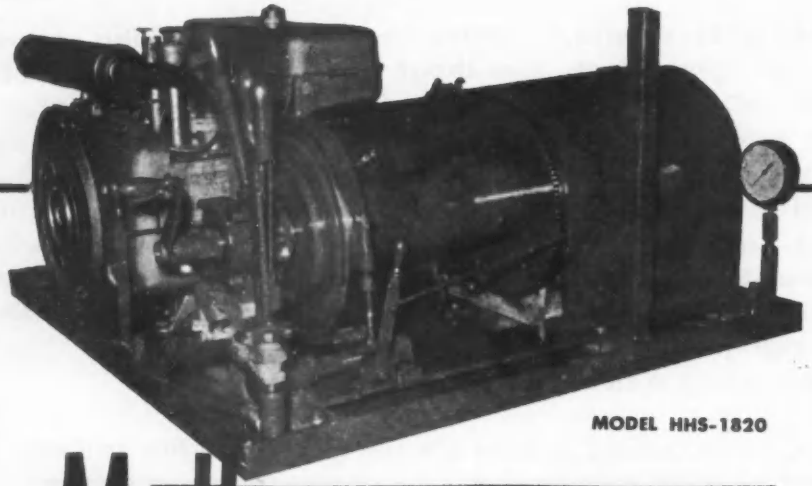
phases of aviation, Sikorsky flew the first successful helicopter in the U. S. in 1939, among many notable achievements.

•

Continental-Emsco Company announced the following changes in store managers. **Donald F. Woods** was promoted to the position of store manager at New Harmony, Ind. Woods was formerly a storeman at this point. **John W. Bohn,** formerly store manager at Continental-Emsco's New Harmony outlet, was transferred as store manager to Salem, Ill. **J. W. Ady,** field salesman at Edmonton, Canada, is now store manager at Drayton Valley, Canada. **Frank Ellis,** formerly store manager at Houma, La., is now store manager at New Iberia, La. **Emery Lasseter** will be store manager at Houma. Lasseter was stationed at Tulsa. **Richard L. Cavnar** has been appointed store manager at Shreveport, La. **Robert H. Pace,** field salesman at Hobbs, N. M., will move into the Post, Texas, outlet as store manager.

•

Robert M. McMahan has retired as secretary of **Bovaird Supply Company** as of June 1 after 46 years of service with the company. McMahan started as price and billing clerk at Bovaird's Sapulpa store. The Sapulpa store was the first store established by Bovaird. McMahan is joining his son-in-law, **Dr. Herbert True,** professor of marketing at Notre Dame University, in the mail order jewelry business. The firm, the Sterling Artists of America, established by True, is being moved from South Bend, Ind., to Tulsa.



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Mathey Reels are available in many sizes with various drives and controls in combinations to completely meet every requirement. Choose your type of control — hydraulic or mechanical, your capacity, your line speed and pull, and your type of power—hydraulic air, electric or internal combustion engine.

Mathey's many years of experience guarantee you extra heavy duty construction, precision machining, oversize bearings and forged steel drum flanges. Mathey also engineers and manufactures specialty reels to fit your individual requirements.

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Allan D. Blackledge

J. W. Brougher

Cameron Iron Works, Inc. announced the promotion of **Allan D. Blackledge** from manager of the Special Products department to assistant manager of the company. **J. W. Brougher** was named the new manager of the Special Products department. Blackledge came to Cameron in 1950 as manager of the Ordnance division. Brougher joined Cameron in 1954, and in 1955 he was advanced to chief of estimating and pricing.

•

William V. Traeger, a former F.B.I. man, has joined **Otis Engineering Corporation** as director of training and recruitment. He will be assigned to the firm's home offices and manufacturing plant in Dallas. Traeger was with the F.B.I. for six years. He was stationed in New Jersey and in Dallas and participated in several major criminal, extortion and kidnapping cases solved by the F.B.I. In his new position with Otis he will direct an expanded training program for plant, field, sales department, and other employes for Otis.

•

ALCO Products, Inc. announced the election of **John P. DeLaney,** former general manager of the company's Transportation division, as a vice president. DeLaney will be in charge of operations in both the Transportation and Spring and Forge divisions. He will report to **W. S. Morris,** ALCO's executive vice president. DeLaney joined the company at Schenectady in 1937 in the Manufacturing department. Four years ago he was appointed manager of transportation product sales, a position he held until last October, when ALCO decentralized its administrative structure and Delaney was named to head the Transportation division.

John P. DeLaney

•

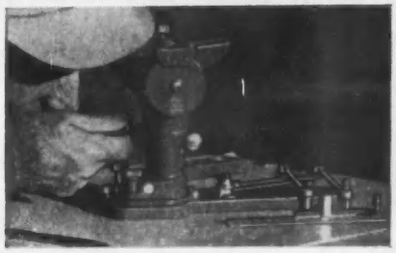
M. C. Cornish has been elected secretary and treasurer of **Mid-Continent Supply Co.** He has been with Mid-Continent Supply since 1945, coming with the company originally as chief accountant.

•

Henry Davis, Jr., has been appointed assistant manager of branch sales for the Mechanical Goods division of **United States Rubber Co.** Davis joined the rubber company in 1945 as a technical trainee in mechanical goods. In 1955 Davis became district sales manager for mechanical goods at the Baltimore branch office.

For today's competition . . .

TURN TO KERN INSTRUMENTS



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KERN RK SELF-REDUCING PLANE TABLE ALIDADE

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- Eliminates slide rule, dividers, offset scale.
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FACTORY TRAINED PERSONNEL

Kern And Only Kern Offers You the Latest Designs of Dr. Henry Wild

Kern SWISS *The FINEST in SURVEYING EQUIPMENT*

KERN INSTRUMENTS INC.
120 Grand St., White Plains, N.Y.

The following year he was named district sales manager of the Pittsburgh office, and he leaves this post to take over his new assignment. His new headquarters will be the rubber company's main office in New York City.

•

Frank C. Smith, Jr., has been named general sales manager of **Southwestern Industrial Electronics Company** of Houston, one of the Dresser Industries. Smith joined SIE in 1953 as a member of the Test Instrument Sales department. He was named assistant sales manager in 1954. Smith was a member of the Geophysical Research department of Humble Oil & Refining Company prior to joining SIE. In his new post he will be responsible for SIE geophysical, test instrument and control equipment sales.

Frank C. Smith, Jr.

•

W. E. Strittmatter was promoted to assistant treasurer of **Mid-Continent Supply Co.** Formerly general office manager and chief accountant, Strittmatter has been with Mid-Continent since 1945.

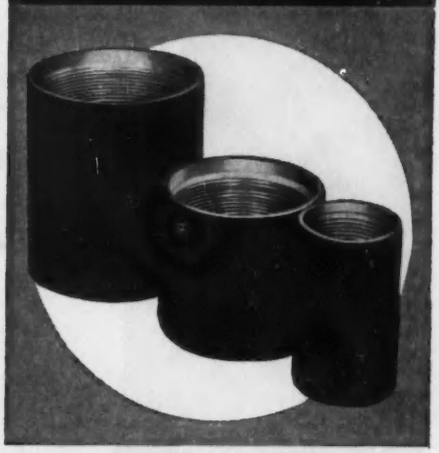
•

Geo. W. (Jack) Walton, president of **Ideco**, one of the Dresser Industries, has announced five personnel changes which will enlarge the staff at the Dallas headquarters of the company. **Jack Hilder** has been appointed assistant to Ideco vice president **Gordon Wilbur.** Hilder, who joined Ideco in 1948, will manage the production of Full-View masts and an enlarged line of Ideco slush pumps. **Johnny McPeak**, assistant manager of the Full-View Mast department, will have primary responsibilities in production control of Full-View and Junior Full-View masts and substructures. McPeak has been with the mast department of Ideco since he joined the company in 1953. Also in that department, **Ray Klingler** has been transferred from the Ideco Technical Service department in Mexico City to the Dallas headquarters to assist in the production and inspection of masts. **Clyde Bloss**, previously an Ideco service representative, has been appointed assistant to central service manager **J. C. Young.** Bloss joined Ideco in 1936. **Turgut Ulug**, technical service engineer, has been transferred from the Houston office to assist Ideco vice-president **E. F. Shiels** in domestic sales and Hilder with the Ideco pump program. **Bob Alderdice** has joined the Ideco Advertising department as assistant to advertising manager **R. M. Perdue.**

•

Ward E. Guin has been named manager of a new re-aligned division of **National Tank Company**, Tulsa. The Oklahoma City division consists of Oklahoma, Kansas and the Texas Panhandle. **Lynn W. Burrus**, with headquarters in Oklahoma City, replaces Guin as Oklahoma district manager. **Joe L. Wells** will be district manager of the Texas and Oklahoma Panhandles and the Hugoton area of western Kansas. **Sam Mays** will continue as dis-

ALL COUPLINGS for the oil industry



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Sizes ⅛" through 12", 14" and 16" O.D. Black and Galvanized. Recessed, Taper Tapped ¾" per foot.

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Short and Long, sizes 4½" through 13⅜". All threads 8 round, ¾" taper per foot. Combination casing couplings also available.

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Non-Upset sizes 1.900" through 4½". Upset sizes 1.660" through 4".

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Couplings-Standard Merchant, 3000 and 6000 lb. Hydraulic and all other types of special couplings.
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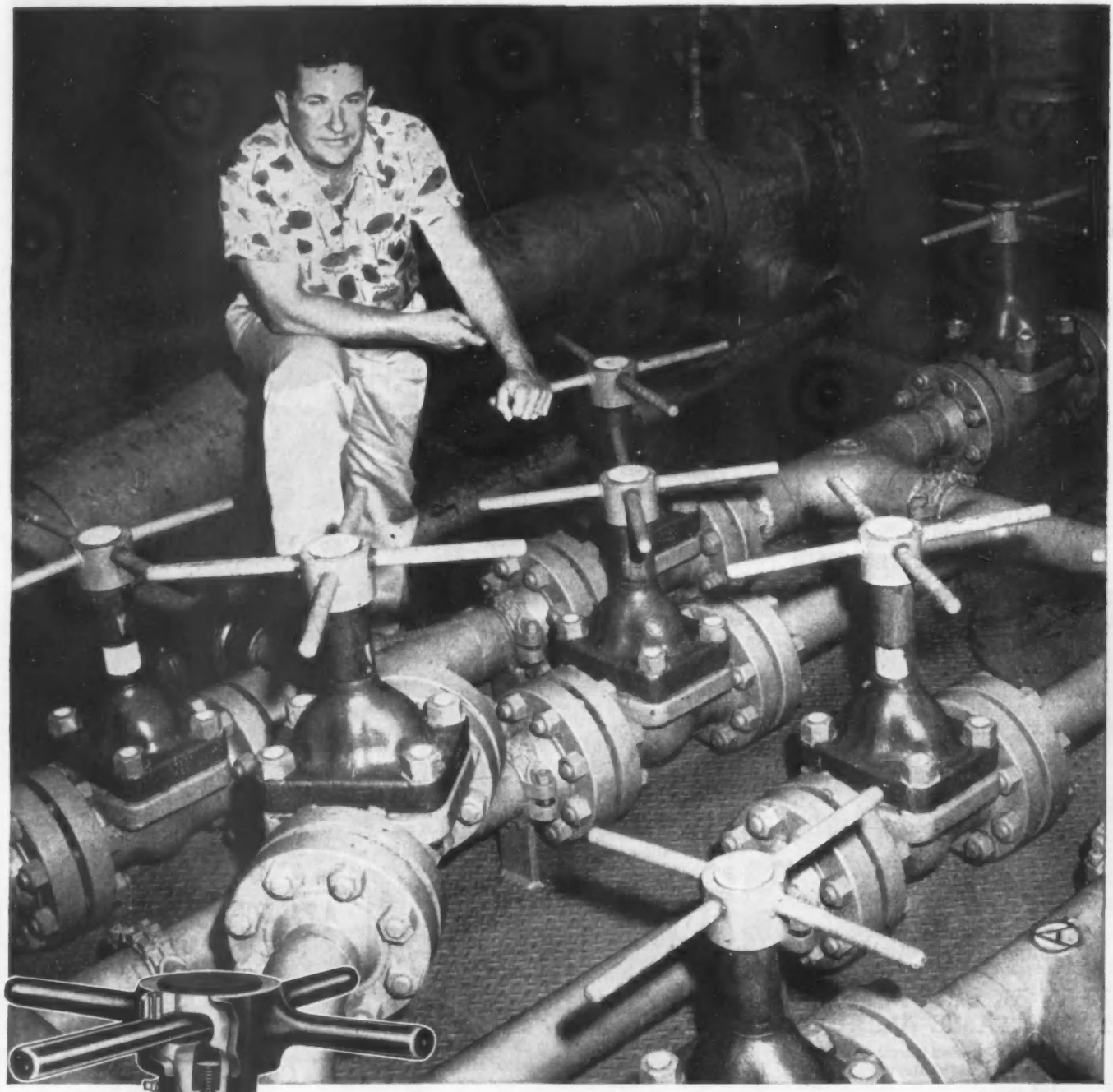


Reports from everywhere prove—Rockwell Built

MUDWONDER Outworks, Outlasts ANY OTHER MUD VALVE!

You, like S. T. "Buck" Dotson (above), toolpusher on Big Chief Drilling Company, Rig. No. 32, will be convinced that your best mud valve buy is MUDWONDER once you've tried it.

Here is a mud valve that was designed, built, and sold for one purpose—to handle oil drilling muds efficiently and economically regardless of the sand content or lost circulation material. It's a big order, but MUDWONDER valves take it in stride.

Big Chief was one of the drilling companies selected to do the original MUDWONDER field testing several years ago. The crew members of Rig. No. 29 on which the test valve was installed were told to use, abuse, and prove the MUDWONDER on their toughest service.

Now, reports from all over the U.S.—overseas, too—prove that MUDWONDER valves can take harsh treatment and still outperform, outlast other mud valves.

That's why every contractor and toolpusher who has tried the MUDWONDER insists new rigs be equipped with MUDWONDERS and old rigs have MUDWONDER replacements.

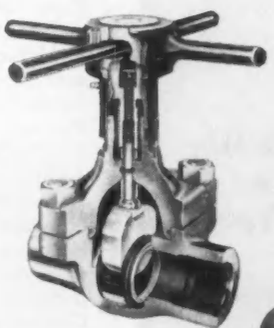
Edward Valves, Inc.

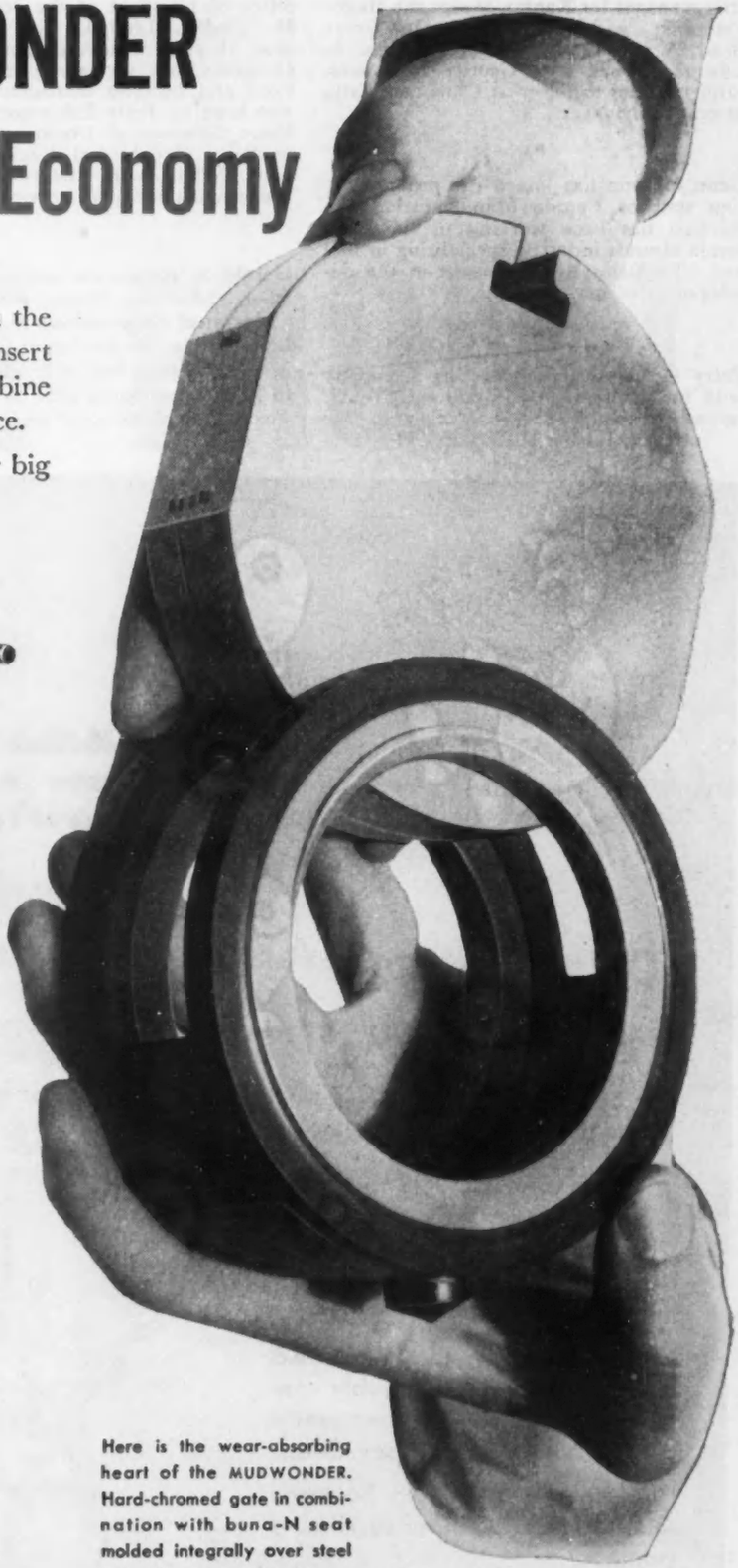
Why The MUDWONDER Gives Mud Valve Economy

A hard chrome gate which is separate from the stainless steel stem plus a buna-N(Hycar) seat insert integrally molded over steel wear rings combine to resist abrasion—give long, dependable service.

In addition MUDWONDER provides seven other big operating advantages:

- **Keeps mudlines intact**
- **Operates easier, faster**
- **Seals drop tight**
- **Stops sanding**
- **Cuts maintenance**
- **Slashes downtime**
- **Assembles easily**





Here is the wear-absorbing heart of the MUDWONDER. Hard-chromed gate in combination with buna-N seat molded integrally over steel wear rings resist abrasion.

EASY TO INSTALL... EASIER TO MAINTAIN

Longer wearing parts which can be replaced easily and quickly are causing the big switch to Rockwell Built MUDWONDER by cost-conscious drillers.

Whenever maintenance is needed, the operation is simple. Bonnet assembly lifts off without disturbing the mudline hook-up.

Inspection or part replacement, if necessary, can be made while the crew is making a connection. Extra seats and, perhaps, a gate for each size—both are interchangeable between pressure classes—are all the parts inventory you should need.

Drilling men have tried MUDWONDER—even abused it—to prove its economical superiority for installation, operation and maintenance. As a result, drilling men everywhere are replacing troublesome mud valves with MUDWONDER.

Ask your favorite oil field supply store for complete information, or write, call, wire Edward Valves, Inc., East Chicago, Indiana. Shipments are made from East Chicago or the Edward Houston warehouse at 1606 Maury St. through the supply store you select.

Edward Valves, Inc.
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ROCKWELL MANUFACTURING COMPANY
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Send me your latest MUDWONDER catalog and price list for 3000 psi WP (6000 psi test) and 2000 psi WP (4000 psi test) mudline valves.

Name_____

Company_____ Title_____

Address_____

City_____ Zone_____ State_____

trict manager for Kansas, except the Hugoton area, with headquarters in Great Bend. A new branch has been opened at Liberal, Kansas, with **George T. Powers**, formerly sales engineer at Oklahoma City, as branch manager.

•

Gene Johnson has joined the product design staff of **Enardo Manufacturing Co.** Johnson has been working in the California aircraft industry, specializing in fuel and oil systems. He will assist in the development of new products.

•

Petty Geophysical Engineering Company with home offices in San Antonio, Texas, recently announced the election to the office of president of the company, **Fred H. Lindall.** Lindall, who joined Petty after 18 years with Anderson-Prichard Oil Company, has specialized in public relations and business management. He will also head up Petty Laboratories, Inc., and Petty Geophysical Company, subsidiaries of Petty Geophysical Engineering Company. While with Anderson-Prichard he was promotional and servicing engineer.

•

Harold S. Tipton was appointed manager of the Sundown, Texas, store of **United States Steel Corporation's** Supply division. Employed by the division at Odessa, Texas, in 1947, Tipton left its employ for a time in 1952, returning in 1953 to Denver City, Texas. Later that year he was appointed field representative at McCamey, Texas, and was transferred to Odessa in 1955.

•

McCullough Tool Company Eastern division has announced the following personnel changes. **Bruce January**, sales engineer, has been transferred from the McCullough Eastern division headquarters in Houston to El Campo, Texas. **D. B. Petty**, sales engineer, formerly at Hominy, Okla., has been transferred to Wewoka, Okla., and **T. E. Austin** has been promoted from sales engineer in Oklahoma City sales office to branch manager at Medicine Lodge, Kansas.

D. B. Petty

•

United States Steel Corporation's National Tube division's Sales department announced two major appointments. **William J. McKee**, who is presently general manager of sales, will become assistant vice president—sales and **Robert E. Williams**, director, distribution and availability, U. S. Steel Corporation, is appointed general manager of sales, succeeding McKee. McKee began his business career with National Tube Company in 1912 in McKeesport. Williams started his steel career as a draftsman in the General Sales department of the former Columbia Steel Company in San Francisco in 1935.

•

Newton H. Willis, manager of the **Waukesha Motor Company's** Railway division, has been named a vice president of the company. He started his career with Waukesha in 1930 as a design and engineering draftsman, and in 1933 began work with the newly-formed Railway division, then known as the Refrigeration division, where he progressed to the post of general manager, and gained wide experience in the fields of railway and bus air-conditioning, truck and freight car refrigeration and engine-driven electric generating equipment.

Newton H. Willis

•

Atlas Powder Company's directors today effected several changes in the board and officers of the company. **Preston W. Parvis**, secretary and treasurer of the company, was elected a director. He succeeds **William J. Wiley**, who has resigned as a director and financial vice president. **D. J. Carroll Copps** and **Edward J. Goett**, now vice presidents, were designated senior vice presidents. **Robert J. Reilly**, presently director of the company's Economic Evaluation department, was also elected an assistant treasurer. With the foregoing changes in directors, the Atlas executive committee now will have the

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NOW . . .
in 3 sizes
14" - 20" - 24" Sheaves
8 - 12 - 25 Ton Capacities
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FLOOR BLOCKS
to meet your every requirement
Alloy steel flame hardened Sheaves mounted on double row Timken Bearings — Permanently sealed with J-M Klipper Seals.
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CHOOSE FROM!

660 bhp. to 100 bhp.

Excess horsepower in a field compressor, above and beyond its inherent overload carrying ability, is fine if you have a use for it. But when it is horsepower that can't be made to earn its way, it's money down the hole.

With twenty-four sizes to choose from, Clark can deliver a packaged compressor that's tailored exactly to your horsepower needs in the 100-660 bhp. range. You can realize substantial savings by avoiding the installation of an improperly sized unit just because "it's all that's available".

When you need flexibility, Clark can give you that also. Every Clark field compressor has a maximum number of compressor cylinders. With many units, you can work two sands simultaneously or, if you have to move a unit to a new field, radically different operating conditions can be handled with a minimum of change-over.

Clark CFA, HMA and HMB packaged field compressors are proved machines. They are the only field compressors available that have been specifically designed for the job. Their balanced/opposed design eliminates the need for massive foundations . . . just enough to level them is ample.

Your nearest Clark office has a specialist on field compressors. Call him . . . he will be pleased to give you all the facts and figures.

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One of the Dresser Industries
Offices in Principal Cities Throughout the World

CLARK®

Packaged Compressor Stations

For more data on advertised products, use Readers' Service Cards, last page.

following members: **Ralph K. Gottshall**, chairman, **Charles C. Gammons**, Copps and Goett. Gottshall is president of Atlas, and Gammons is a vice president and general counsel. Members of the company's finance committee will include **Isaac Fogg**, chairman, and Gottshall and Parvis. Fogg is chairman of the Atlas board of directors. **John H. Leary** had been appointed assistant to the president. Leary previously had been assistant to the financial vice president.

•

Michael Toth was appointed manager of Turbocharger sales of **De Laval Steam Turbine Company**, Trenton, N. J. Prior to this appointment he was serving as acting manager of turbocharger sales since February, 1957. Toth joined De Laval in 1949.

Shown at Continental-Emsco's annual banquet are seated left to right W. T. Powell, executive vice president, manufacturing and engineering, Continental-Emsco; J. L. Mauthe, chairman of the board, The Youngstown Sheet and Tube Company, F. I. Brinegar, executive vice president, distribution, Continental-Emsco; F. M. Mayer, president of Continental-Emsco; W. J. Morris, retired chairman of the board, Continental-Emsco; and Walter E. Watson, vice chairman of the board, Youngstown Sheet and Tube.

Company Wide Sales Meeting Held by Continental-Emsco

Continental-Emsco recently held its first company wide sales meeting after the first-of-the-year consolidation. The three-day meet was held at Dallas, headquarters for the oil field manufacturing and supply company.

Over 250 members of the organization attended from the oil country of the U. S., Canada and South America.

Otis Pressure Changes Name; Reassigns 2 Division Managers

Otis Engineering Corporation has announced that Bob Crain, veteran manager of the firm's Oklahoma City division, has been transferred to Corpus Christi, Texas, as division manager. Duane Johnson, superintendent for the Otis division in New Iberia, has been promoted to district manager in Oklahoma City to replace Crain.

Crain replaces W. K. (Jug) Waters who has been reassigned to Otis' South American subsidiary company, Servicio Tecnico de Pozos "Otis" C. A. He will be assigned to the Otis camp at Lake Maracaibo, Venezuela.

Prior to his transfer to Oklahoma City, Crain was district manager for Otis in Longview, Texas. Johnson has also been stationed in the Otis branches in Houma, Victoria and Corpus Christi.

Otis Engineering Corporation is a new name for Otis Pressure Control, Inc., effective June 30. The new name was adopted as being more descriptive of the present-day tools and services which the firm markets.

Canadian Fairbanks-Morse Appointed Climax Distributor

The Canadian Fairbanks-Morse Company, Ltd., has recently been appointed Canadian distributor of Climax engines. This new affiliation gives Climax complete sales and service facilitates throughout Canada.

Use the "Royal" to look into oil and gas opportunities in Canada

To meet the specialized needs of oil and gas men the Royal Bank maintains an Oil and Gas Department in Calgary. This department is a clearing house for the latest on-the-spot information, channelled in from branches operating in all proven fields and in many areas that are new and promising. For fast, informed banking service, geared to the requirements of the industry, call on the "Royal"—Canada's oil bank.

Write to The Royal Bank of Canada, Oil and Gas Department, 409 Eighth Avenue West, Calgary, Alberta, for a list of current "*Oil and Gas Bulletins*". These "Bulletins" are revised constantly, will bring you up to date on regulations, tariffs, oil and gas financing, basic statistics, and kindred subjects.

We do not provide information on oil securities.

572

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Over 900 branches in Canada, West Indies, Central and South America.
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The renovated quarters of Oilfield Sales and Service.

Oilfield Sales and Service Expands Venezuelan Facilities

The office and warehouse of the Western Division of Oilfield Sales and Service S.A. located in Urbanizacion Sucre front of Plaza in Maracaibo, Venezuela has recently been enlarged and remodeled. A new warehouse has just been completed in Tia Juana to accommodate the increased activity on the eastern side of Lake Maracaibo.

The operations of the Western Division are under the direction of Jerome C. Kearby. The Eastern division of oilfield sales and service is managed by Paul C. Koester with its office and warehouse located in Anaco.

Both divisions represent Garrett Oil Tools, Texas Iron Works, Byron-Jackson, Christensen Diamond Products, S. R. Bowen Company and Emsco Screen Pipe Company in Venezuela.

Entire Franks Division To Move From Tulsa to Pampa, Texas

Manufacturing facilities and employes of Franks Division, Cabot Shops, Inc., will be moved from Tulsa to Pampa, Texas, in the near future. Operation of sales and service facilities will be continued in Tulsa in a new sales and parts stock building which will be built as soon as arrangements can be made.

The move is being made to consolidate overhead and manufacturing costs with the Cabot plant which has modern material handling facilities, better arrangement and is equipped with modern machine tools.

Unit Rig Successfully Tests Mobile Bridge Launcher Model

Unit Rig & Equipment Co. is putting into production a mobile assault bridge launcher. First production model of the launcher was successfully tested by the company in Tulsa last week before a group of top-ranking U. S. engineering and military personnel.

Consisting of an automatic heavy-duty hydraulic mechanism mounted on an M-48 heavy tank chassis (tank minus combat gear and turret), the launcher handles either 40-foot or 60-foot bridges. Protected by armor and controlled by the tank driver, the launcher within minutes can lay down a bridge to move traffic up to 60 tons across ravines, tank traps or other troop determents at the rate of 300 vehicles an hour.

Unit Rig received the contract for the launchers a year ago. Since that time, some of the firm's large staff of design engineers have worked closely with the U. S. Corps of Engineers in arriving at final plans for the first production model.

Raybestos-Manhattan Opens New Odessa, Texas, Warehouse

Raybestos-Manhattan, Inc., Passaic, N. J., announced the opening of a new warehouse at Odessa, Texas, to service the Odessa and adjacent oil field areas. This is located at 411 West First Street and will be operated by the Dallas district under E. W. Nagel, district manager.

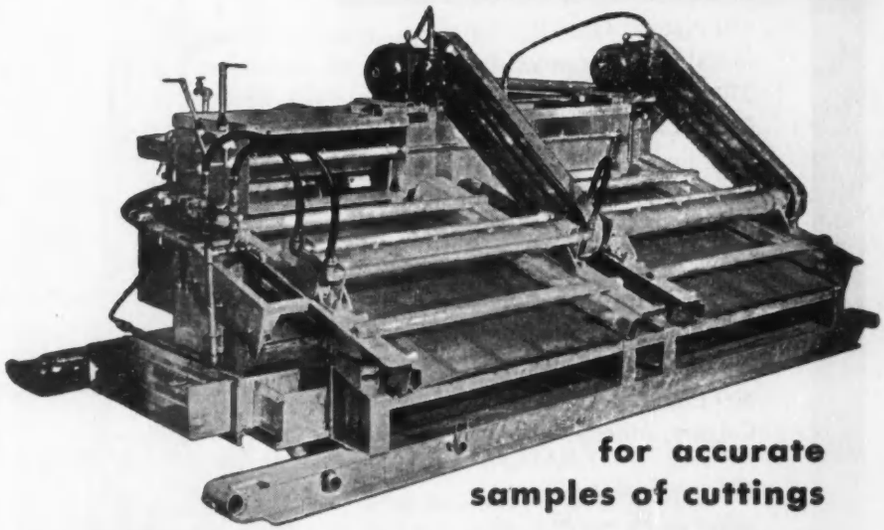
Adequate space and facilities are available for stocking ample supplies of rotary and other types of hose, V-belts, Poly-V drives, packings and oil field friction material.

Rector Well Equipment Opens Pampa, Liberal Warehouses

Rector Well Equipment Company has opened a new warehouse at Liberal, Kansas, with operations on a round-the-clock

Thompson

DOUBLE VIBRATING SHALE SHAKER...and SAMPLE MACHINE



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A pioneer in financing Canadian oil developments, The Canadian Bank of Commerce has a complete staff of experienced men in our Petroleum and Natural Gas Department in Calgary. Our more than 270 branches throughout Western Canada keep us in constant touch with local developments. You are invited to consult with us regarding any phase of the industry in Canada. Write or telegraph to C. H. Munro, Manager, Petroleum and Natural Gas Department, 309 Eighth Avenue, West, Calgary, Alberta.

(*We regret that we cannot advise on the merits of oil or mining securities.*)

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basis. John R. Pinkerton is in charge of the operation.

At the same time the opening of a warehouse at 401 West Atchison Street in Pampa, Texas, was announced. James Wilson heads up the operations there.

The warehouses at Liberal and Pampa will provide service for the complete Texas, Oklahoma and Kansas Panhandle area.

Harold E. Newlon

W. B. Hudson

Alten Foundry & Machine Expands Texas Operations

A series of moves to enlarge Alten's Texas activities was announced recently by Warren M. Benson, vice president of Alten Foundry & Machine Works, Inc., Lancaster, Ohio.

W. B. (Bill) Hudson, formerly Alten's North Texas representative residing at Jacksboro, has been named Texas district manager. Hudson has moved to Odessa where he will have his headquarters and supervise the opening of a new Alten warehouse.

Harold E. Newlon has been appointed to replace Hudson in the North Texas area and is now residing, with his wife and two children, at 1619 Collins Street in Wichita Falls. Newlon, a native of Kansas and an ex-Marine, brings to Alten a wealth of oil field experience gained in responsible sales positions with several major supply companies.

SSC's Southern Division Moves To Houston; Baum Is in Charge

The transfer of the Southern division headquarters of Seismograph Service Corporation from Tulsa to Houston was announced. Robert B. Baum, assistant vice president, will be in charge of the Southern division, with offices in the Texas National Bank Building.

G. H. Westby, president, said the reasons for the transfer of the division headquarters are to bring the office in closer contact with field operations in the southern division, which includes all of the states bordering the Gulf, and to provide on-the-spot supervision for SSC crews.

Baum joined SSC in 1941. Working with Baum as technical supervisor will be E. B. Lindsey, who recently returned to the U. S. after more than ten years abroad as geophysical supervisor for SSC and its foreign subsidiaries.

Construction of Huge Rig Underway at Avondale

An immense offshore drilling structure left the drawing boards recently and is now under construction at Avondale Marine Ways, Inc. This is the Loyd Noble S-66, a special type elevated deck drilling barge for use in offshore oil operations. It is being built by Avondale for the Noble Barge Company, and will be used by The California Company for drilling in waters

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of up to 100 feet depth in the Gulf of Mexico.

According to an estimate by Calco engineers, the height—from the bottom of the spuds some 100 feet below the surface of the mud when in operating position, to the top of the two-well derrick—is about the equivalent of a 36-story building. The barge proper measures 217 feet 6 inches length overall by 100 feet 0 inches beam by 14 feet 0 inch depth.

A helicopter deck, four 800 horsepower diesel engines for the generation of electricity, and big mud pumps designed for efficient drilling operations, are among other special features of the barge.

Construction of the S-66 will be carried out at Avondale's main yard, just above New Orleans on the Mississippi River, throughout the remainder of this year.

Cosasco's enlarged El Monte, Calif., division.

VARCO

Type SRL-Long Rotary Slips Provide the—Long Life—Safety—Low Maintenance Costs Needed for the Deepest Drilling!

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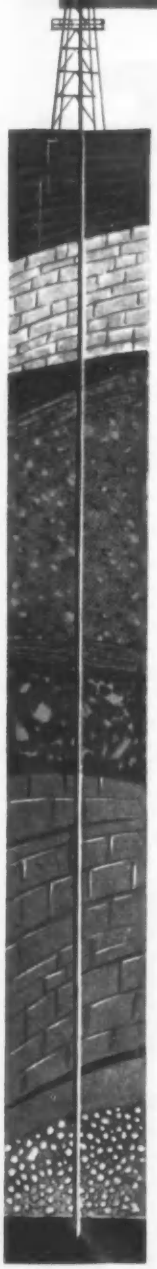
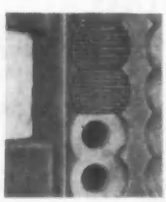


VARCO type SRL-Long Rotary Slips are especially designed, carefully manufactured and the most modern controlled heat treatments are employed to produce highest quality performance. They have the greatest amount of line contact per weight and equal size of any Rotary slips. Their advanced design combines light weight with high ultimate strength to provide the greatest possible protection for deep drilling.



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Jay P. Gould

D. M. Etter

Cosasco Quadruples Quarters In El Monte, California

Cosasco Division of Perfect Circle Corporation, manufacturers of "Access" fittings and "Unitized" wellheads, has announced moving into new headquarters at 11655 McBean Drive, El Monte, California. The new plant has four times the floor space of the former location in LaCanada and is more convenient to transportation and related industries.

L. Auer

Key personnel of the Cosasco Division are Jay P. Gould, general manager of Cosasco and founder of the predecessor company, Corona Oil Specialties and Service Co.; D. M. Etter, sales manager and Leland Auer, manager of engineering.

The Cosasco Division was formed on June 5 last year when Perfect Circle Corporation, piston ring manufacturers of Hagerstown, Indiana, acquired the company. Products of the division include special nipples which permit entering lines and vessels against pressure, mandrels or tubing hangers, wet plugs and "Unitized" wellheads for wells, various corrosion-control accessories such as coupon holders, water samplers, thermo-couples and hydrogen probes for insertion through the nipples against pressure, and "Retrievers" (lubricators) with which to manipulate insertion or removal of plugs and accessories against pressure.

So. Michigan Representative Named for Aldrich Pump Co.

The Aldrich Pump Co., Allentown, Penn., manufacturers of power pumps and hydraulic equipment, announces the appointment of the DuBois-Webb Co. as exclusive sales representative for the company's products in the southern peninsula of Michigan.

RESERVOIR ENGINEERS

(Ages 27-38)

A major integrated U. S. oil company operating in Venezuela has outstanding career opportunities for qualified RESERVOIR ENGINEERS. Excellent growth possibilities are present in an expanding technical organization. Graduate engineers and physicists who have had FIVE to TEN years of specialized and general petroleum reservoir engineering experience are invited to submit a complete resume of work experience and personal data. Naturally, all replies will be held in confidence and interviews arranged for qualified candidates. Salary, including bonus, $14,900-$18,000, depending on qualifications and experience. Company is a leader in the petroleum industry with excellent employee benefits, including home vacations with travel expenses.

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The expanding technical organization of a major integrated U. S. oil company operating in Venezuela has outstanding career opportunities and excellent growth possibilities for qualified petroleum engineers. Position vacancies exist at levels requiring FIVE to TEN years of specialized or general petroleum engineering experience. MECHANICAL ENGINEERS who have had experience in the design and construction of crude oil producing facilities, oil gathering stations, water flood projects, etc. are preferred. Applicants are invited to send complete resume of work experience and personal data. Replies are of course confidential. Personal interviews will be arranged for qualified candidates. Salary, including bonus, $14,800-$18,000, depending on qualifications and experience. Company is a leader in the petroleum industry with an excellent schedule of employee benefits, including home vacations with travel expenses.

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Clearing Way to "El Dorado"

If the oil well that will be sunk on this site comes in, this International TD-18 crawler tractor may be said to have cleared the "way to El Dorado." The crawler, equipped with a dozer, is shown completing a site for the well, south of El Dorado, Ark., near the Louisiana line. Owner of the TD-18, Lambert Barr Construction Co., Waldo, Ark., also uses another TD-18, and an International Drott TD-9 skid-shovel to clear and level sites for drilling.

Dowell Sends Adkison to Tulsa; Reorganizes Eastern Districts

Dowell Incorporated has completed the reorganization of its three eastern U. S. districts. The area involved in the reorganization program includes all of the states east of the Mississippi River except Michigan.

All of Dowell's industrial services east of the Mississippi River, except Florida, will now be handled from the Cleveland district office. All oil field services, except for Michigan, will be managed from Salem, Ill. Florida industrial chemical services and sales activities will be supervised by Dowell's Houston office. The company's Michigan oil field business will continue to be managed from its Mt. Pleasant, Mich., district office.

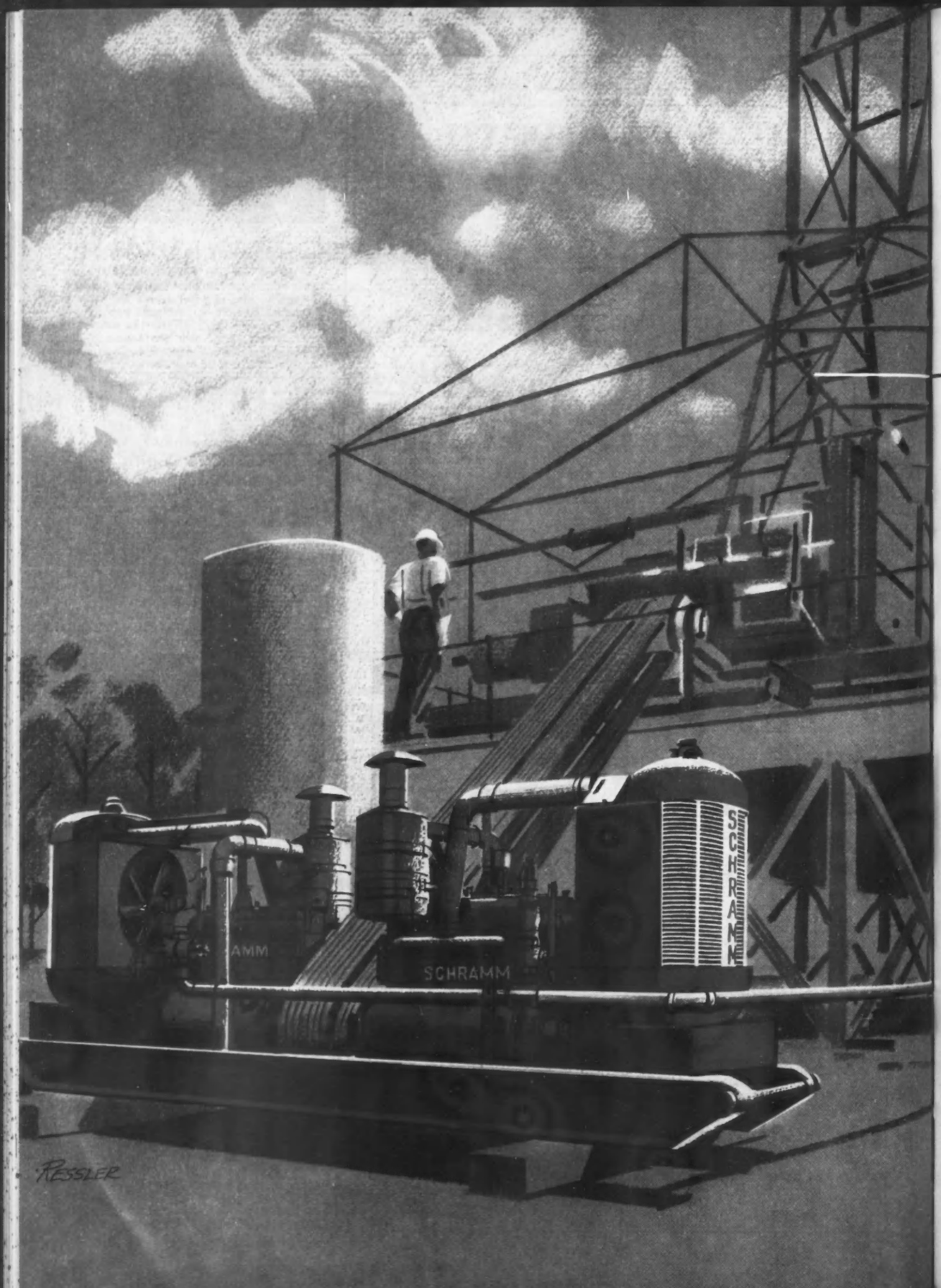
All employes of the company who had been assigned to the Ardmore district will now report to Cleveland. The Ardmore office has been closed and its people transferred to Mt. Holly, N. J., where Dowell has recently completed a service and sales headquarters.

The Cleveland district office will continue to be under the supervision of E. C. Hardy. I. R. Bielek has been transferred from St. Louis to be district operations manager at Cleveland. L. J. Kutlich will continue as manager of the Salem district with J. R. Paul of Carmi as district operations manager. J. H. Adkison, formerly manager at Ardmore, has been transferred to Dowell's general offices in Tulsa where he is now assistant to D. E. Ramsey, manager of operations.

Reo Motors Becomes Division Of White Motor Company

Robert F. Black, chairman of the board and chief executive officer of The White Motor Company, and Simon D. Den Uyl, president of the Bohn Aluminum & Brass Corporation, announced that White Motor has purchased the assets of Reo Motors, Inc., of Lansing, Mich., from Bohn for an undisclosed amount of cash.

The White Motor Company will operate Reo as a division under the direction of John C. Tooker who will be general manager of this division. Reo's general offices, including manufacturing and sales, will continue to be at the present plant in Lansing, Mich.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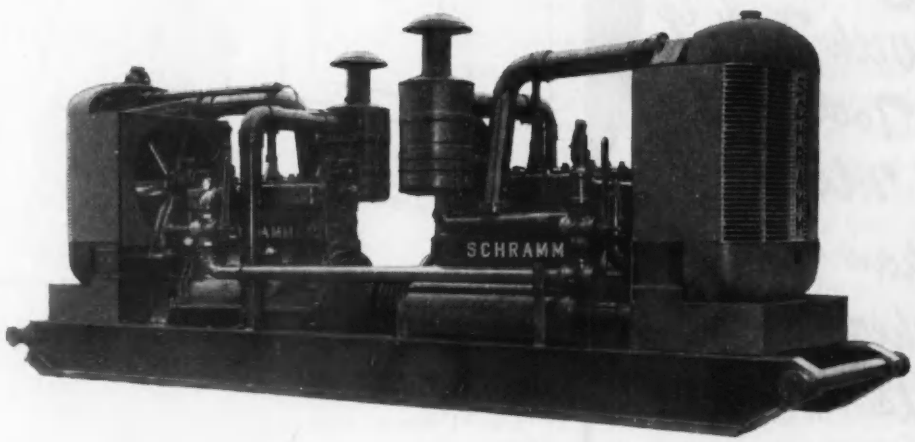

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Ruggedly designed for oil field service, the skid-mounted Model 1200 requires a minimum of maintenance. Any engine mechanic can service . . . few parts required—readily available for emergency service.

Buy or rent. Schramm Model 1200 units are available for rent or purchase. Your dealer or supply store can give you details.

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Dead Giveaway

Son: "I thought I asked you not to tell Mother what time I got in last night, Mandy."

Cook: "Ah didn't, Massa Jim, Ah just said that Ah was too busy gettin' breakfast to notice the clock."

Swish!

A little girl was telling of her hospital experience where she had an appendectomy, "They told me it would not hurt and then they stuck a needle in my arm and I disappeared."

Candy Kittens

Some children were going to give their school teacher a candy shower, so all the children brought candy except one little boy who brought a basket containing five small kittens and their mother.

When asked why he didn't bring any candy, the little boy responded, "I did! I brought five all-day suckers and one milky way."

From the Sage

You should save your money, if you can. It may be valuable again some day.

Careful With the Mix

A discriminating gentleman seated himself at the bar and ordered a martini. "Very dry," he cautioned the bartender. "Twenty parts gin to one part vermouth."

"Very well, sir," the bartender replied, "Shall I twist a bit of lemon over the top?"

"My good man," rejoined the gentleman, "when I want lemonade, I'll ask for it."

No Main Dishes

Cannibal King: "What am I having for lunch?"

Cook: "Two old maids."

King: "Ugh, left-overs again."

His Mother Loves Him

Julius came bursting into the kitchen crying bitterly. "The kids beat me up Ma; they said I have a big head."

"Now, Julius, just don't believe them. It's not true that you have a big head."

So, partly convinced, Julius calmed down. "Now Julius, run down to the store and get me ten pounds of potatoes."

"Okay, Ma, gimme a bag to carry 'em in," replied Julius.

"A bag? What do you need a bag for?" asked his mother. "Carry them in your cap."

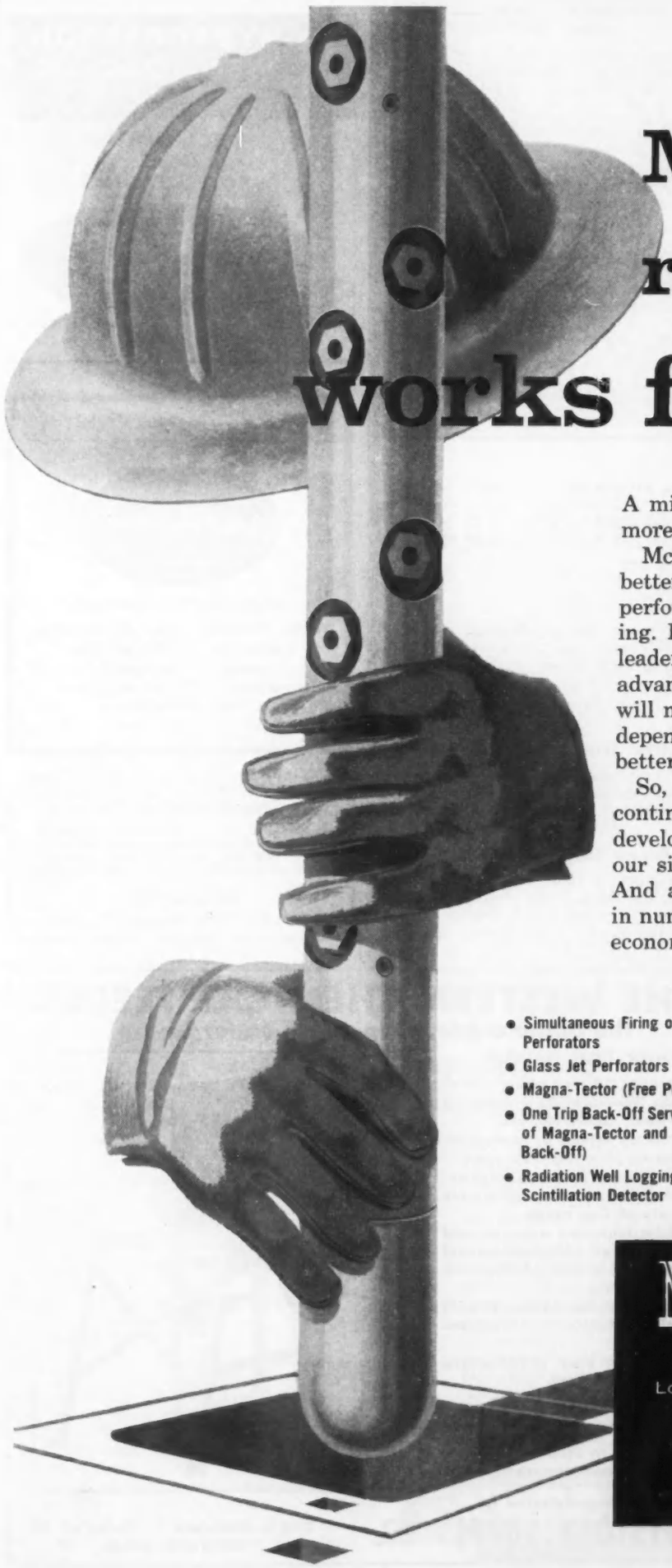
Even Steven

Daughter: "Father, can my new boy friend replace your business partner who died yesterday?"

Father: "It's all right with me—if you can arrange it with the undertaker."

Give It to Him

The Devil was looking over his new arrivals one day and seeing one of them



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McCullough's search for new services—for better, more efficient, more economical ways of performing existing wire line services—is unending. For, here at McCullough, we realize that leadership depends upon our ability to meet, in advance, the technical demands the oil industry will make upon us in the future. Our earnings depend upon our ability to produce new and better services of real value to the oil man.

So, the upward technological climb must continue. As the results of our research and development go to work for you out in the field, our size and stature increases in the industry. And as we grow, our research projects grow in number and complexity—searching for more economical means to find and produce oil.

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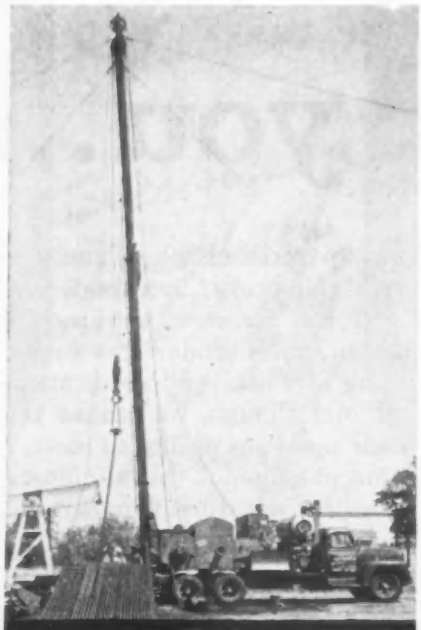

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Well Servicing Units

Wichtex Units "open the door" to more profit—in well servicing. They provide more capacity, more efficiency per dollar invested. They are designed specifically to require a very minimum of upkeep and repairs. They are outstandingly compact and mobile; models up to 9,000-foot capacity are available within 8-foot width. They have an unequalled record for long life without overhaul. They are your best buy.

Models range from 2,000-foot to 12,000-foot capacity. All models can be equipped with spudding attachment.

Also investigate Wichtex Rotary Rigs for 2,000′ to 5,000′ drilling.

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WICHITA FALLS TEXAS
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strutting around like a peacock, he spoke to him. "You act as if you owned the place," he said.

"I do," said the new resident, "my wife gave it to me."

Pet Peeve

A workman was perched on top of a ladder cleaning the clock in the city building and a Nosey Joe called up to him: "Something wrong with the clock?"

"No, I'm near-sighted."

The Dirty Truth

Confucius say: "Man who crosses ocean twice and doesn't take a bath is a dirty double-crosser."

Way Down Under

Once upon a time the fence between Heaven and Hell broke down. St. Peter appeared at the broken section and called out to the devil: "Hey, Satan, since all

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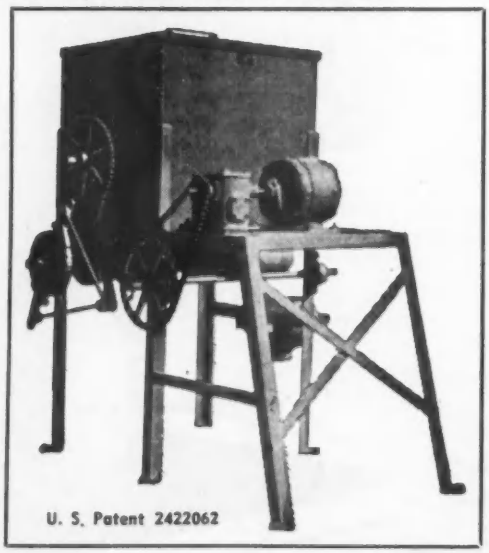
THE WESTERN CHEMICAL FEEDER
the dependable, economical water treater

CHECK THESE FEATURES:

- Used in Oil Well Water Flooding, Municipal Water Treating Plants, Canneries, etc.
- Can be driven by water entering plant for treatment.
- Maintains pre-set water-chemical ratio through a wide rate-of-flow range.
- Adjustable two ways, to feed from a few pounds to several hundred pounds of chemicals per day.
- Also can be equipped with electric motor, or gas engine drive.
- Made to your specifications in various sizes.
- In use the world over.

Whatever your water treating problems may be, investigate the Western Feeder. Write for literature and prices.

For complete description see Page 2843 of the Composite Catalog.



U. S. Patent 2422062

Manufactured By
KEYSTONE SUPPLY CO.
312 E. Cherokee St. Phone LD-10
NOWATA, OKLA.

WORLD OIL

"Let them watch us drill. It's their planet, you know."

the engineers are over in your place, how about getting them to fix this fence?"

"Sorry," replied Satan. "My men are all too busy to go about fixing measly fences."

"Well, then," replied St. Peter, "I'll have to sue you if you don't."

"Oh, yeah," countered the devil, "and where are you going to get a lawyer?"

Leave Things Be

The family was having gardening problems and the wife told her husband that he ought to do something about their lawn, which was all dried up and turning brown. He replied: "Okay dear, I'll spread some manure on it tomorrow."

Later the couple's grown daughter told her mother: "That word 'manure' is disgusting. I do wish you would tell daddy to say 'fertilizer'."

Replied the mother: "Believe me, I had enough trouble teaching him to say 'manure'."

The Very Latest

"Why don't you ever get to work on time?" growled the fashion photographer.

Answered the mannequin: "I'm a late model."

Another Viewpoint

Husband: Maybe we can figure out what the problem is.

Wife: I know what the problem is; it's having too much month left over at the end of the money.

Convincing Evidence

"You look downcast."

"Yep. My wife was away six weeks and I wrote her every week and said I spent all my evenings at home. She's back now and the light bill came in. It's for fifty cents."

Hi-Fi Capers

After the young husband had completed his application for membership in the High Fidelity Music Appreciation Society, he was asked about membership for his wife.

"I don't think she could belong," he explained.

"That is peculiar," the secretary answered, "most anyone can belong."

"My wife is peculiar," the husband replied, "she's low on fidelity and high on frequency."

Or I Won't Pay Fare

Have you heard about the drunk who got into a cab outside Howie's Restaurant and said to the driver, "Take me to Howie's."

The disgusted hackie opened the door and yelled to the lush, "Buddy, you're in front of the place."

The guy looked out at the club, turned to the driver, and screamed, "Okay, but, nexsht time, don't drive so fasht!"

Soak in Water

Little Johnny, age 3, did not like soap and water. One day his mother was trying to reason with him, "Surely you want to be a clean little boy, don't you?" she said.

"Yes," tearfully agreed Johnny, "but why can't you just dust me off like you do the piano?"

Salesman Till He Dies!

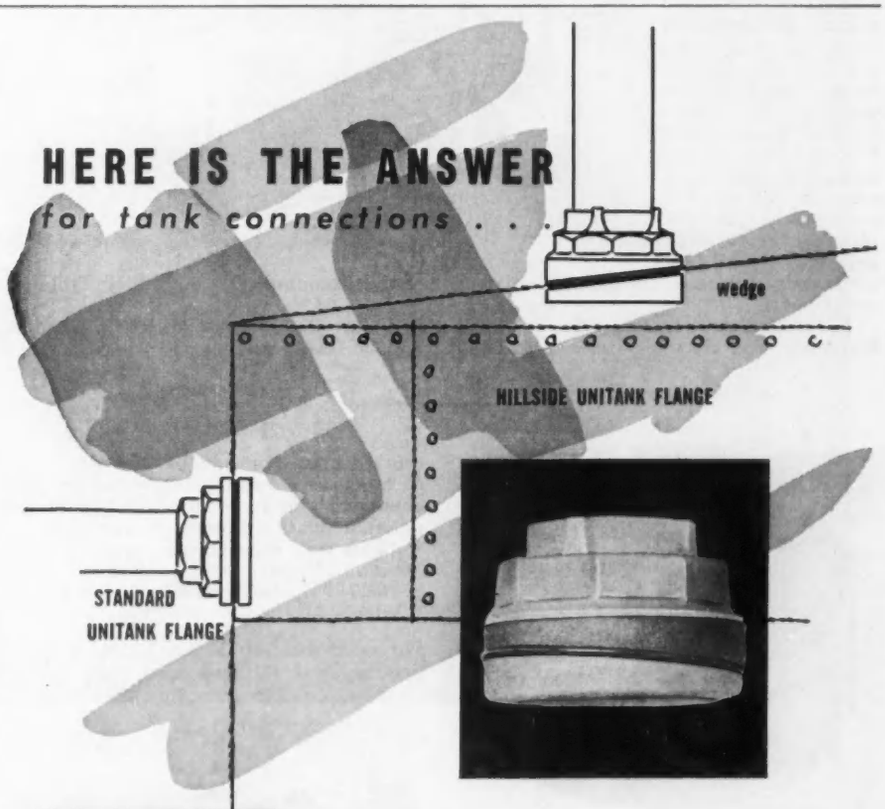
A new car dealer was dying. The great specialist who had been called in as a last resort finished his examination and approached the sick bed.

"I'm sure I can cure you," he said, "but it will require a delicate operation."

"How much?" whispered the new car dealer.

"My fee will be $2400," replied the specialist. The new car dealer roused himself to reply:

"You'll have to shave that price a bit, Doc," he gasped weakly, "I've had a better offer from the undertaker."



ENARDO UNITANK FLANGES

The ENARDO Unitank Flanges are made to fit either flat decks (Standard) or sloping decks (Hillside). They are cast of sturdy metal, precision machined, easily installed, and economical because of labor saved at installation. The "Hillside" flange consists of a body, wedge, and retaining nut, designed for connections on the slope of standard tank decks. This flange keeps all overhead piping vertical. Not at an unknown angle, i.e. a standard flange on sloping deck. (See illustration.) The "Standard" flange consists of a body and retaining nut. It is designed for installation on all tank walls. On both type flanges, body extends through tank plate from the inside with gasket between body and plate. Retaining nut is tightened from outside (see illustration). Left-hand threads are machined on both body and retaining nut; this causes the flange to tighten instead of loosen when receiving standard pipe, from either the inside or outside. Only one hole needed for "Hillside" or "Standard" flanged installation. Both flanges have had universal acceptance in the oil fields.

Call, write or wire ENARDO for further information.

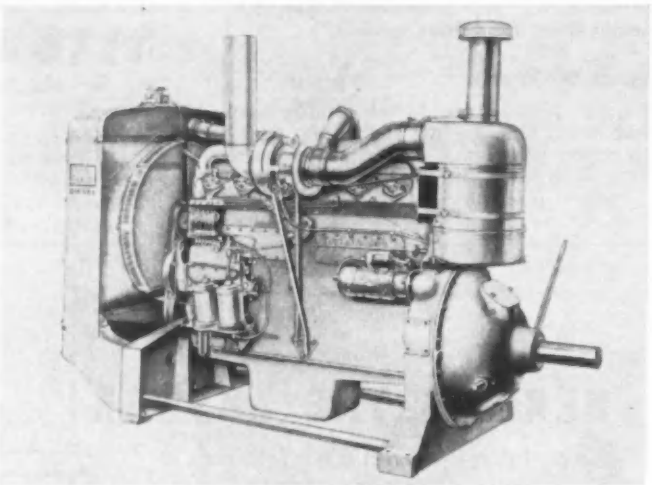
ENARDO manufacturing company
BOX 1647 TULSA, OKLA

For more data on advertised products, use Readers' Service Cards, last page.

What's New In Equipment

Drilling • Production • Exploration

250 HP Power Unit

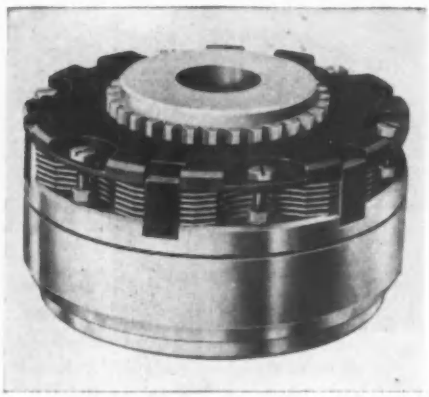


International Harvester Company has entered the turbocharged engine field with its new 250 horsepower Turbotorque UDT-1091 power unit.

This 250 brake hp rating is attained at 1500 revolutions per minute, an increase of 50 hp over its naturally-aspirated counterpart, the UD-1091, previous top-hp unit in the International line of 18 power units. The new 6-cyl. unit has all the features of the UD-1091, plus the cost-cutting, dependable - adding advantages inherent in its turbocharger components.

(This item supplements International Harvester Co., data on Pages 2742-2745 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E1** on Readers' Service Card, last page this issue.



Magnetic Clutch

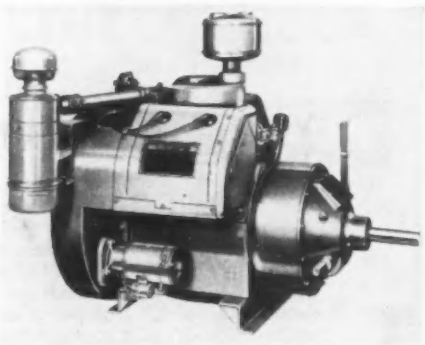
Fawick Airflex Division, Fawick Corporation, announces the new Fawick magnetic clutch. Patented design features include comparatively narrow axial, and small radial dimensions, complete isolation of the magnetic assembly from the integral mechanical parts and compact, precision assembly of all component parts. It is furnished in stationary field or brush types and is easily adapted to "dry" operation.

Many operating advantages are claimed for the Fawick Magnetic Clutch. First among these is its unmatched fast operating speed in both engagement and disengagement. Delay time and residual drag are reduced to an absolute minimum by effective isolation of the magnetic assembly from the clutch friction components.

The Fawick Magnetic provides complete control of acceleration or deceleration, plus exceptional torque under all rated conditions—with instant remote control through push buttons, relays or limit switches. They are easily adapted to modern machine tools and have a wide range of bore sizes. Fawick Magnetics are self-contained, and do not produce axial thrust or other relative motions on machines.

(This item supplements Fawick Airflex Division, Fawick Corp., data on Pages 1776-1777 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E2** on Readers' Service Card, last page this issue.



Air-Cooled Engine

With the introduction of Wisconsin Motor Corporation's new Model VR4D, manufacturers and users of engine-powered equipment are now offered a greatly expanded power range . . . never before attained in heavy-duty, industrial type air-cooled engines. This engine is rated at 56 horsepower at 2200 revolutions per minute.

Features include Stellite exhaust valves and valve seat inserts, used in conjunction with positive-type valve rotators for 200 percent to 500 percent longer valve life, according to the manufacturer . . . tapered, self-cleaning, main roller bearings on both ends of the crankshaft . . . a rotary type, outside magneto . . . positive oil lubrication . . . and efficient air cooling to 140° F.

(This item supplements Wisconsin Motor Corp. data on Page 5562 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E3** on Readers' Service Card, last page this issue.

Rust-Proof Coating

A new, corrosion-resistant coating that can be applied by brush, roller or spray, has been developed and proved by the Permaspray Manufacturing Corporation, League City, Texas. The company states that metals properly cleaned and coated were submerged for 18 month periods in hydrochloric acid, caustic soda, salts, gasoline and fuel oils, without signs of breakdown.

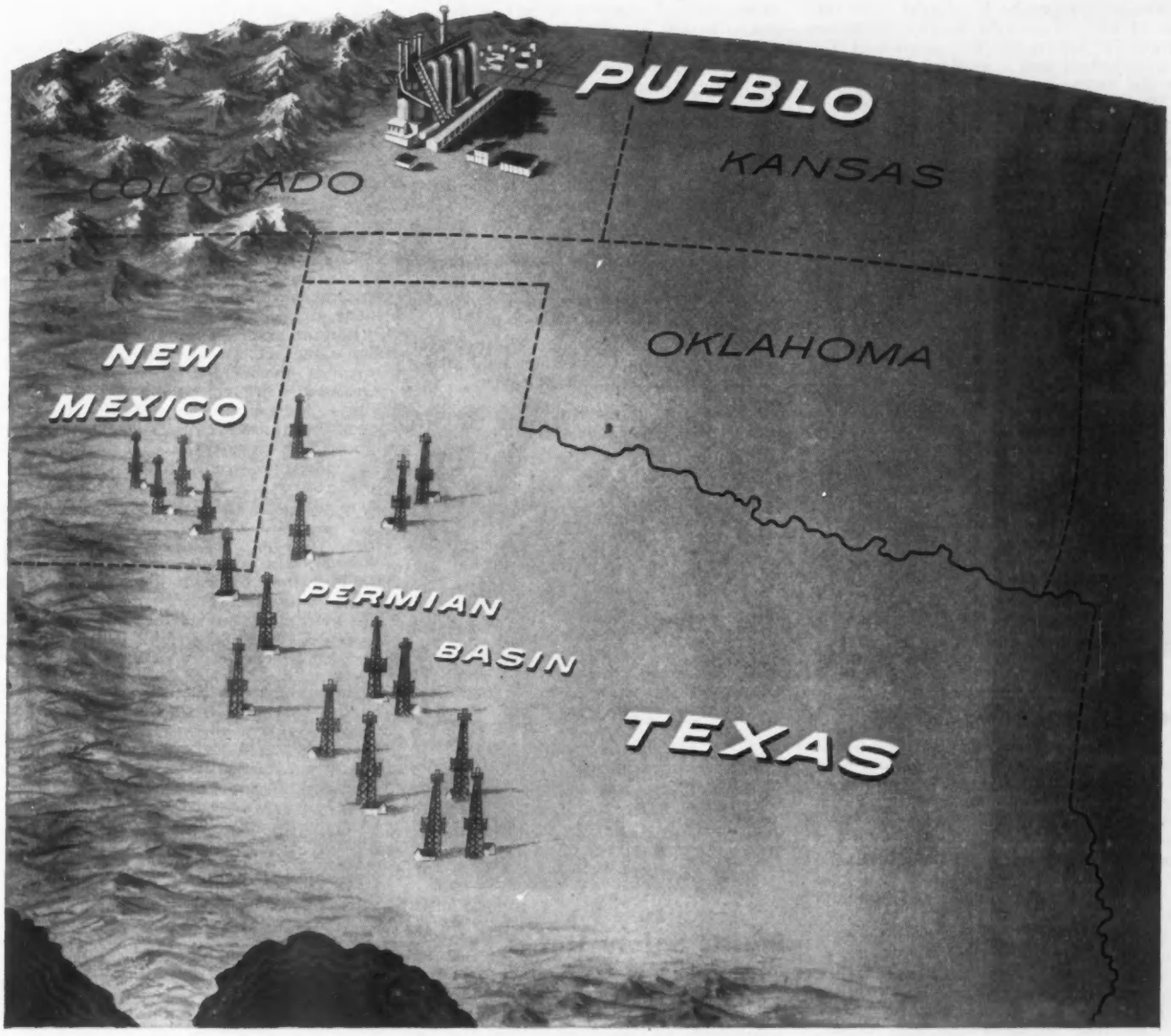
In tests made on all types of surfaces in a Gulf Coast plant under severe conditions, parts of structures coated with Permaspray have withstood three years exposure to hydrochloric acid, caustic fumes, and weathering conditions. For best protection, two coats of Permaspray should be applied, each coat approximately 3 mils thick; each coat dries to a hard finish in four hours.

For more data, circle **No. E4** on Readers' Service Card, last page this issue.

Light-Weight Survey Recorder

An all-purpose, light-weight, portable depth recorder for use in hydrographic survey work is found in Bludworth Marine's new Model ES-130, which includes the latest electronic improvements and performs with flexibility and precision.

Model ES-130's single barium titanate transducer weighs less than four pounds and is made to prevent introduction of harmful turbulence when operated at vessel speeds of eight knots. In normal operation the transducer and mounting tube



you'll see

CF&I SEAMLESS CASING AND TUBING

all over the Permian Basin...

Rig operators in the Permian Basin know from first-hand experience that CF&I is a desirable source for top-rate seamless oil country casing and tubing. For—ever since it opened its modern tube mill at Pueblo—CF&I has enjoyed the privilege of serving this important production and exploration area.

Oil men all over the West will tell you the same story. CF&I Seamless Casing and Tubing is top quality. CF&I controls every phase of operations required in the manufacture of its seamless casing and tubing—from the mining of its raw materials to the finished product. This step-by-step control assures a product of high quality.

Available in standard sizes from 2⅜" to 9⅝" O.D., CF&I Seamless Oil Country Casing and Tubing meets or exceeds API STD 5A specification. Ask your CF&I representative for the complete story today.

CF&I

SEAMLESS TUBULAR PRODUCTS

THE COLORADO FUEL AND IRON CORPORATION

Denver, Colorado

4479

For more data on advertised products, use Readers' Service Cards, last page.

combination may be hand-held over the side of a small boat or secured by other means. For fishing or other small boat use of a special adapter is available for mounting the transducer to the hull.

The complete equipment, less power source, weighs less than 40 pounds, the recorder unit case being so designed that the sectionalized mounting tube, transducer and cable stow inside the case when not in use.

For more data, circle **No. E5** on Readers' Service Card, last page this issue.

New Speed Reducers

A new worm gear speed reducer which incorporates antifriction ball bearings both for input and output shafts has now been developed by Tulsa Winch Co., Tulsa. Labeled Model G4S, the new reducer provides 29 to 1 reduction, is rated at 875 foot-pounds output torque, and is designed for intermittent operation. Weight is held to 36 pounds by use of cast-aluminum housing.

This new reducer can be driven by electric, gas, hydraulic motor or manually, or by single speed power take-off is truck mounted. The reducer can be furnished with a niggerhead if desired.

(This item supplements Tulsa Winch, Division of Vickers, Inc., data on Pages 5170-5171 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E6** on Readers' Service Card, last page this issue.

Air Intake System

To provide efficient and economical operation in the new White Tractor in both the 9000T and 4000T Series, The White Motor Company has introduced a new type air intake that operates automatically, under all weather conditions.

When outside air temperature is below 70° F., the thermostat in the air induction system control chamber is in closed position to outside air, thereby drawing warm air from under the hood. This provides a quicker warm-up for efficient operation of the White Mustang engine. The air induction controlled air temperature chamber is an integral part of the air cleaner. This design eliminates unnecessary hoses and possibility of air leakage.

When the underhood air temperature is over 80° F., the thermostat will open the valve, allowing cool outside air to enter the air induction system. For underhood air temperature of between 70° and 80° F., the thermostat will modulate, in proper proportion, warm air from under the hood and cold air from outside.

(This item supplements White Motor Company data on Pages 5389-5408 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E7** on Readers' Service Card, last page this issue.

Plastic Safety Hat

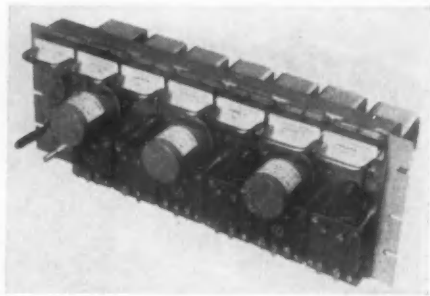
Development of a new all-plastic safety hat has been announced by General Textile Mills, Inc., of Carbondale, Penn.

Available in two models, the GenTex #105 brimmed hat and the GenTex #205 peaked cap, the new safety headgear is constructed with a completely new plastic shell. In addition to exceeding all standard safety requirements for resistance to pressure, impact, combustion and voltage, the newly developed plastic shell withstands violent extremes in temperature, and is especially useful in zero and sub-zero climates. The new hat incorporates the widely favored GenTex suspension system, which provides superior comfort and protection and is readily washable in either commercial or home laundry machines.

For more data, circle **No. E8** on Readers' Service Card, last page this issue.

Audio-Tone Transmission

Centralized supervisory control systems can now utilize the many distinct advantages of transistorized audio-tone transmission. Up to 18 functions, telemetering and controlling, may be transmitted over a single pair of private or leased wires, carrier current, radio or microwave mediums. This type of transmission has proved ideal in economically centralizing the control of remote functions found in both municipal and industrial applications . . . for telemetering such quantities as pressure, temperature, level, flow, turbidity, chlorine residual, pH, conductivity and many others.



Ease of assembly, interchangeability, installation, and system expansion are features of the compact, completely transistorized plug-in design of the power supply, transmitters and receivers. The 100 percent transistor circuits eliminate costly tube power consumption and maintenance. Specially developed circuit design eliminates frequency interference on adjacent channels.

These units were developed in conjunction with and manufactured by the Warren Mfg. Company, Inc., exclusively for Builders-Providence, Inc., a division of B-I-F Industries, Inc.

For more data, circle **No. E9** on Readers' Service Card, last page this issue.

Platform Pipe

Master Tank and Welding Company, manufacturers of pipe line pipe, refinery towers and pressure vessels for the petroleum industry, has started production of heavy duty pipe for use in fabricating offshore drilling platforms.

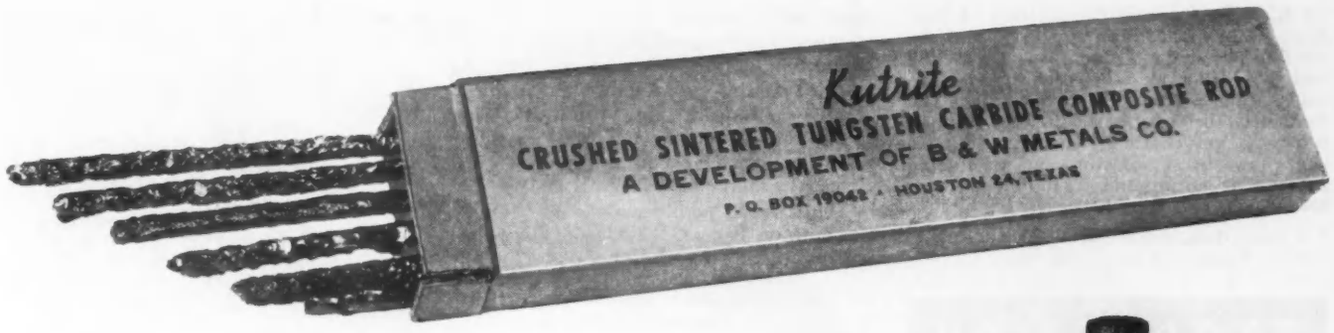
Production capacity for the new pipe will be at the rate of one-half mile per day using regular line pipe mill.

Both sizes of the new pipe are double jointed using a continuous weld.

For more data, circle **No. E10** on Readers' Service Card, last page this issue.

Portable Radiotelephone

A new portable radiotelephone for geophysical applications has been introducd



Kutrite!®

patent pending

the new development that cuts like diamonds!

CHECK THESE KUTRITE FEATURES:

- ✔ New sintered carbides
- ✔ Guaranteed hardness
- ✔ A matrix tensile strength of 100,000 psi
- ✔ Seven carbide sizes from 3/8" - 1/4" to 30-45 mesh
- ✔ Used world-wide by leading fishing tool and major oil companies
- ✔ Simplicity of application allows easy usage by anyone who can braze

SOME KUTRITE APPLICATIONS:

Pulverizer hammers
Core heads
Shot-hole bits
Drag bits
Power shovel bucket teeth
Cutting-type rotary shoes
Burning-type rotary shoes
Junk mills
Stabilizer blades
Window casing mills
Reamers

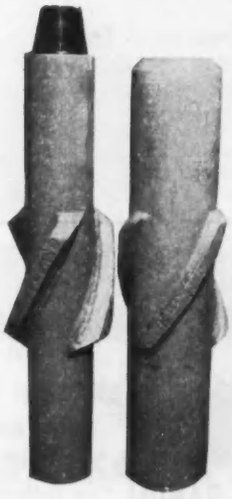
WRITE FOR BROCHURE

B & W METALS CO.

P. O. Box 19042 • Houston 24, Texas

Phone HO 5-6063

KUTRITE (1/4" - 3/16" carbide size) has been applied to this rotary shoe. (Courtesy Wilson Supply Co.)



KUTRITE (size 10-down) has been applied to these stabilizers. User says, "lasts four times longer than old conventional-type stabilizers." (Courtesy Southwest Oil Tool Specialties, Inc.)

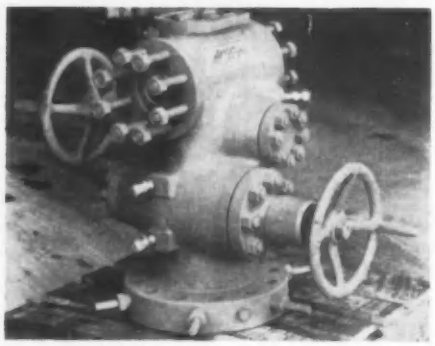
This coring head pulled four 10' Utah rock cores at a complete bit cost of approximately 27c per foot. The seismograph bit has drilled over 200 feet of cement plugs and is still capable of drilling many more hundreds of feet. Both of these tools can be rebuilt with KUTRITE at less than one-half their original cost. (Courtesy Marine Exploration Co.)

For more data on advertised products, use Readers' Service Cards, last page.

by Kaar Engineering Corporation of Palo Alto, Calif. The Kaar TR-247 may be used on any single frequency between 2000 and 8000 kilocycles. Power output of the transmitter is from 25 to 30 watts. The unit may be operated directly from a 6 or 12 volt battery. Current drain is kept low by employing quick heating tubes. The entire unit including carrying case weighs only 52 pounds less battery.

For more data, circle **No. E11** on Readers' Service Card, last page this issue.

PRODUCTION



Dual Valve and Tee

The oil industry's first combination dual bore valve and dual tee—two of the vital components of a dual completion christmas tree in a single piece of equipment—has been produced by the McEvoy Company of Houston.

Known as a Type "DVT" Valve (dual valve with integral tee), the new unit completely eliminates one major flanged connection in a dual completion tree. By eliminating this connection, the DVT also eliminates the assembly time, the ring gasket and the studs and nuts necessary to make the connection. More important, a possible source of leakage is avoided.

(This item supplements the McEvoy Co. data on Pages 3317-3364 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E12** on Readers' Service Card, last page this issue.

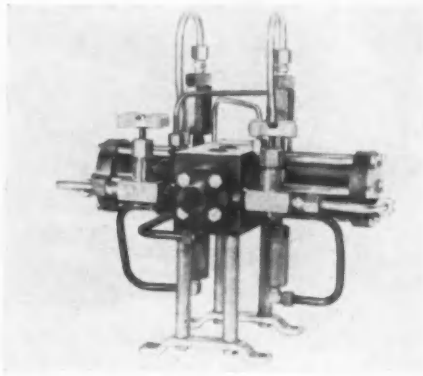
Fill-Up Equipment

In addition to filling the casing automatically from the bottom as it is being run, the new Baker Circulating Flexiflow Fill-Up collar permits circulation to be carried on at any time while running-in the casing.

Use of this Circulating Flexiflow Fill-Up collar eliminates high-pressure surges that might otherwise break down a weak zone or mud-off a producing zone. It fills the casing automatically as it is run, and allows circulation at any time while running-in. And it contains a back-pressure valve that can be brought into action for cementing by merely pumping a Bakelite Ball down the casing to the collar.

(This item supplements Baker Oil Tools, Inc. data on Pages 521-640-D of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E13** on Readers' Service Card, last page this issue.



Glycol Pump

Kimray Inc. announces the addition to their line of oil and gas equipment and controls, their new glycol pump with double-action which eliminates high-pressure liquid-level controls on the absorber plus a small amount of gas (about 3 std. cu. ft. per gallon of glycol at 1500 pounds per square inch) powers the pump.

(This item supplements Kimray Inc. data on Page 2845 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E14** on Readers' Service Card, last page this issue.

Frac-Assist Tool

B. J. Service, Inc., a subsidiary of Borg-Warner Corporation, has developed a new fracturing tool to boost injection rates at high pressure reducing friction and line losses. Known as Frac-Assist, the subsurface packaged power unit is set on packer above the zone to be fractured and when triggered boosts the fracturing force,

Don't Juggle Power House Dollars!

Play It Safe and Certain!

SAND-BANUM Pure Colloidal Concentrate

OUNCES ONLY ONCE A WEEK
Safely and Certainly Remove AND Prevent Boiler Scale & Corrosion.

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In Handy Tablets
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THE HOMOGENIZING FUEL OIL TREATMENT

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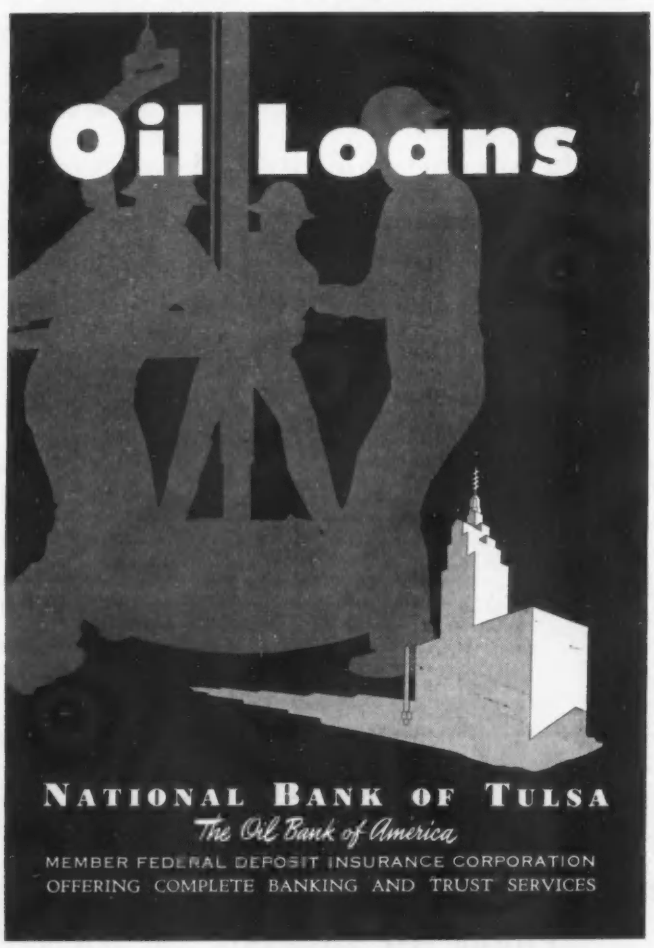
FREEPORT, NEW YORK
SAND BANUM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MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION
OFFERING COMPLETE BANKING AND TRUST SERVICES

AMERICAN IRON
UNIVERSAL "55"
FRICTION CATHEADS

EXTRA POWER

. . . to makeup and breakout any connection!

ON LARGE or small drawworks, American Iron Universal "55" catheads deliver that EXTRA POWER needed to properly makeup or breakout ANY size tool joint connection!

These advantages make the Universal "55" a truly *universal* cathead:

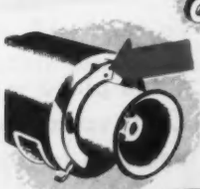
- Most powerful cathead in the field . . .
- Simple and quick installation . . .
- Spin and tong with the same makeup cathead . . .
- Available with air or manual controls . . .
- Smaller overall dimensions . . .
- Removable steel spool increases road clearance.

Available through your Supply Store

Ask any American Iron representative to show you the 10-minute presentation of "THE CATHEAD YOU CAN DEPEND ON."

EXTRA SAFETY!

Safety stationary guard (encloses all mechanism) . . .



Rope divider is mounted to the safety guard . . .

AMERICAN IRON & MACHINE WORKS CO. INC. — MANUFACTURERS OF OIL FIELD EQUIPMENT — OKLAHOMA CITY

AMERICAN IRON & MACHINE WORKS COMPANY. INC.—Oklahoma City, Okla.—Subsidiary of AMERICAN MACHINE & FOUNDRY COMPANY

For more data on advertised products, use Readers' Service Cards, last page.

generating 5000 hydraulic horsepower instantaneously.

The tool, when in position, is triggered from the surface by placing a tubing plug into the frac-fluid stream. When entering the tool, the plug detonates blank cartridges initiating a controlled burning of a gas-generating fuel. A high pressure gas force builds up inside the tool's chamber, exceeding pressure in the tubing, creating a nearly instantaneous downward surge behind the fluid already in the tubing.

The super fracturing force, instantaneously supplied by the tool, creates multiple and highly productive fractures which can be maintained and extended by a normal uninterrupted pumping flow immediately following the tool's striking force.

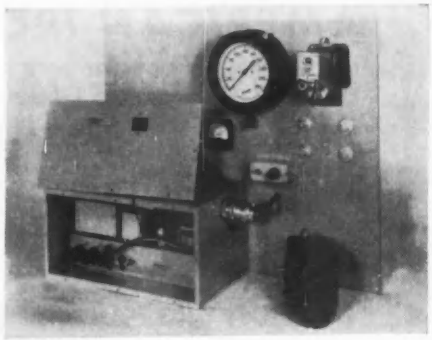
The Frac-Assist process has been field tested to prove its mechanical operation and hydraulic performance and can be run on two-inch tubing inside 5½-inch casing and on 2½-inch tubing for use inside 7-inch or larger casing.

For more data, circle **No. E15** on Readers' Service Card, last page this issue.

Electronic Computer

An inexpensive electronic gas flow measuring system is available from Computers Incorporated and sold through Oil Metering and Processing Equipment Corporation's national sales organization. The system provides the range, accuracy and speed of response comparable to other electronic flow measuring systems.

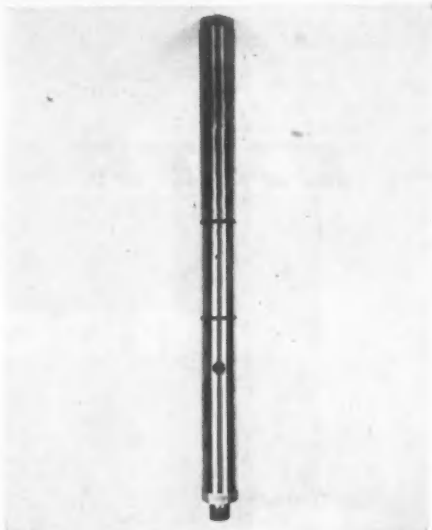
The flow measuring system measures the flow of gas through an orifice plate by means of electrical signals proportional to the flow rate and accumulated flow. An adapter adjusts the instrument's calibration to the conditions of the measurement problem. Adjustments for changes in the measuring problem can be quickly and easily made by changing the plug-in adapter.



The Computer contains magnetic amplifiers, silicon diodes and transistors. It has no moving parts nor does it generate a large amount of heat as do vacuum tube circuits. It is designed to give trouble-free operation.

(This item supplements Oil Metering and Processing Equipment Co. data on Pages 3875-3878 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E16** on Readers' Service Card, last page this issue.



Gas Lift Valve

Mercury Machine & Manufacturing Corporation in Houston has announced the manufacture of the new Mercury gas lift valve. With this valve constant flow in the well can be changed to intermit flow without removing the valve from the well. It is also possible to adjust this valve in the field so that it does not have to be sent back to the manufacturer to be re-set for pressure head. With this valve in the well, less valves are needed due to the greater spacing. Chokes are eliminated for constant flow because the valve is normally in the open position. The choke at the wellhead is sufficient.

Manufacturers claim that less gas is needed for this valve because as the fluid clears the separator, the pressure becomes less and the valve automatically closes. No temperature effect is felt because there is no pre-set pressure in the bellows.

With the valve operating on the rise of fluid in the well annulus no timing device is needed. The static fluid level can be

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in service in the drilling industry
One piece—no welds to break. Drills up to four times more footage with less time and costs spent on fishing jobs!
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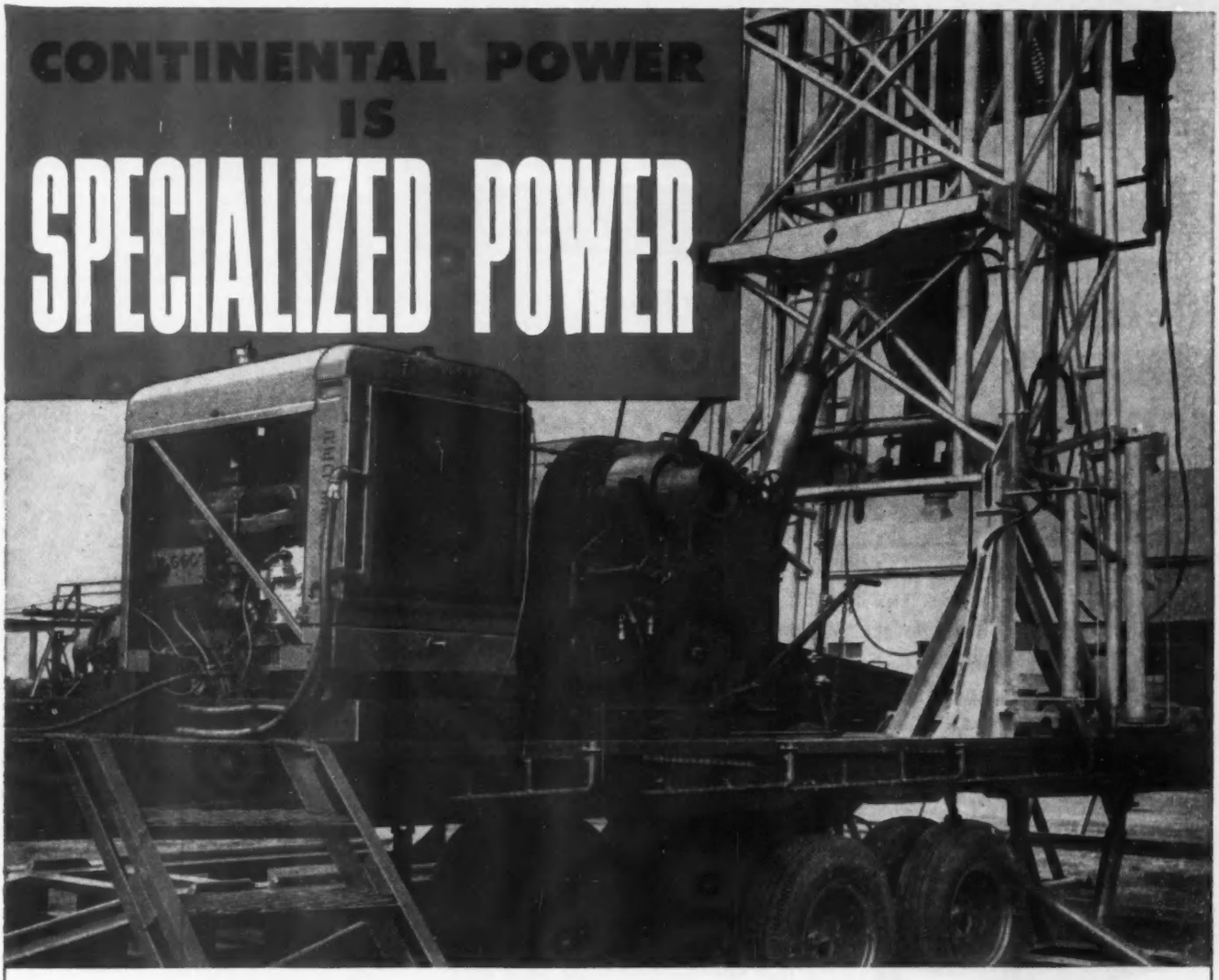

No doubt about it, Continental Red Seal power owes a great share of its fine reputation to the fact that every model is truly specialized—engineered with the needs of a specific application in mind. It delivers extra satisfaction for the simple reason that it's built to do the particular job for which it is designed. . . . The installation shown above is a Spencer No. 5000 drilling rig with 93-ft. portable mast for drilling oil wells to 4,000 feet. Power is supplied by a Continental Red Seal model R602, fuel (LPG), with twin-disc torque converter. . . . You'll find one or more Red Seal models, in a broad horsepower range and at closely-spaced power levels, to match just about every oil field job, in drilling, producing, distribution, or processing —and they're available for operation on all standard fuels. See your oil field supply store or write for information.

•

RED SEAL ENGINES ARE BACKED BY PARTS AND SERVICE EVERYWHERE

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Continental Motors Corporation

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WORLD'S LEADING INDEPENDENT MANUFACTURER OF INTERNAL COMBUSTION ENGINES, CONTINENTAL MOTORS OPERATES PLANTS IN ATLANTA, DALLAS, DETROIT, MILWAUKEE, MUSKEGON, AND TOLEDO, AND IN ST. THOMAS, ONT., PRODUCING AIR-COOLED AND LIQUID-COOLED ENGINES FOR USE ON LAND, AT SEA AND IN THE AIR.

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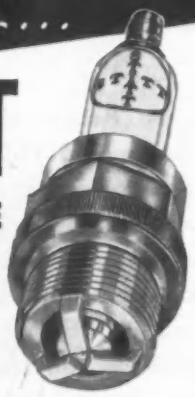


. . . to get peak performance longer, Cooper-Bessemer is now factory-installing STITT New Triple Ignitor Spark Plugs. STITTS last up to 10 times longer, cut downtime, increase magneto life. Also factory equipment in other leading oil field engines.

Write today for FREE Pocket Catalog giving recommended plugs for all your engines—help you get better plug performance.

STITT IGNITION CO.
COLUMBUS 1, OHIO
STITT MAKES HEAVY-DUTY, INDUSTRIAL-TYPE PLUGS!

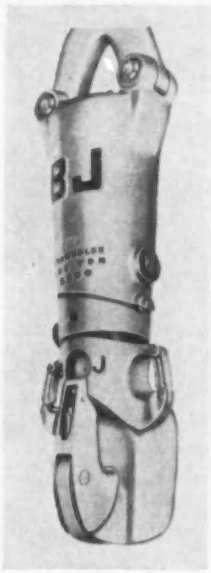
overcome by increasing or decreasing the gas pressure.

These Mercury valves can be adapted to all types of installations.

For more data, circle **No. E17** on Readers' Service Card, last page this issue.

DRILLING

500-Ton Hook



The largest capacity hook ever manufactured for the petroleum industry is announced by Byron Jackson Tools, Inc., a Borg-Warner subsidiary. It is emphasized that the new tool is much more than a beefed-up version of ordinary drilling hooks. Every facet of conventional hook design was studied objectively, and retained only if it could not be improved upon. The result is the "5500," a rugged, streamlined giant created expressly to safely hold the long strings of pipe and casing needed for the deepest drilling operations—both offshore and onshore.

Among the more important features stressed is the patented BJ Hook positioner, which can be preset to automatically turn the elevator door handles so they face the derrickman when the elevator reaches the monkey board. The "5500" also has the exclusive Hydraulic Snubber, which prevents drill pipe bounce, battered joints, and high maintenance.

(This item supplements Byron Jackson, Division of Borg-Warner Corporation data on Pages 973-1108 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E18** on Readers' Service Card, last page this issue.

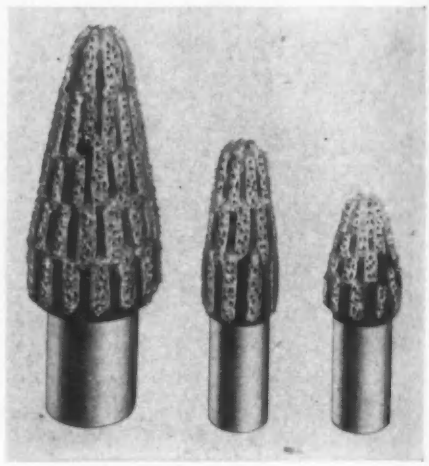
Giant Wire Rope Sling

A new giant in wire rope slings, three inches in diameter and furnished with the patented Dualoc Ending, has been perfected and introduced by the Wire Rope Divisions, American Chain & Cable Company, Inc. The manufacturer recommends its use to fill a vital need in today's expanding materials handling programs for moving heavy power generating, industrial, marine and railroad transportation equipment.

The Dualoc ending, used in all Acco slings, is the only patented fully mechanical ending which will develop full strength of the wire rope throughout the complete size range. One characteristic of the ending is that the heavier the applied load, the greater is the developed holding power. No bursting stresses can be developed in the collars when load is applied.

(This item supplements American Chain & Cable Co., Inc., data on Page 198 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E19** on Readers' Service Card, last page this issue.



Servco Taper Mills

The new Servco taper mills are used with permanent whipstocks to clean out and remove burrs from windows, to mill out collapsed casing, to enlarge holes through adapters or retainers and to mill out a dented or mashed area of casing.

Like other Servco milling tools, the new taper mills are dressed with Servcoloy. This new method of utilizing tungsten carbide in drilling, milling and fishing tools makes possible phenomenally fast cutting speeds. By suspending bits of carbide in a tough, elastic matrix, hundreds of cutting edges are always in contact with the surface to be cut. As particles are worn or torn away, new cutting edges are automatically exposed.

(This item supplements The Servco Co. data on Pages 4697-4720 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E20** on Readers' Service Card, last page this issue.

Casing Scraper

A new casing scraper has been introduced by Gulf Oiltool Company of Houston. This tool removes all foreign material from the inside bore of the casing and therefore assures full clearance for all tools run in the hole plus ascertaining a clean wall for the correct seating of packers.

The tool is of very rugged design and is considerably shorter than conventional scraping tools due to its having full 360 degree scraping action from a single row of scraping elements. Another first in the tool is that it is leased to the user for the life of the scraping elements, after which it is returned. This method is proving to

When there's "LIGHT" available . . .
WHY GAMBLE IN THE DARK?

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on a small plot, or near your lease line,
on a directional job, or to tap a critical zone,

PLAY IT SAFE--*always call* **PGAC**
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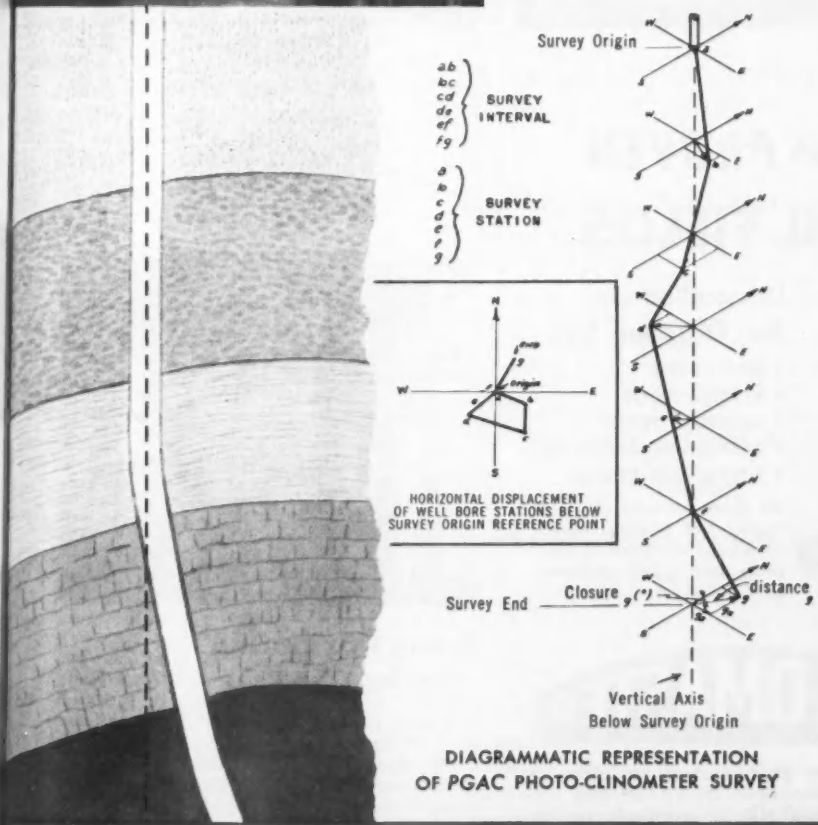

DIAGRAMMATIC REPRESENTATION
OF *PGAC* PHOTO-CLINOMETER SURVEY

PGAC's Photo-Clinometer Survey is the **dependable, fast** and **low-cost way** to KNOW the drift angles and directions of your well-bore — while you can still make corrections — **before** you set bottom casing and tubing.

PGAC's Photo-Clinometer Survey is quickly made with a 3½" diameter magnetic directional surveying instrument that records as many as 100 photographs per run into your well. Each photo reveals your open hole's drift angle from vertical, and the compass drift direction, at any desired depth.

The distance between depths checked, and the number of depths checked, depend upon the degree of accuracy desired for your survey. The 16mm film is then developed, individual enlargements of the photos are made, and a diagramatic representation of the survey supplied.

PGAC-577

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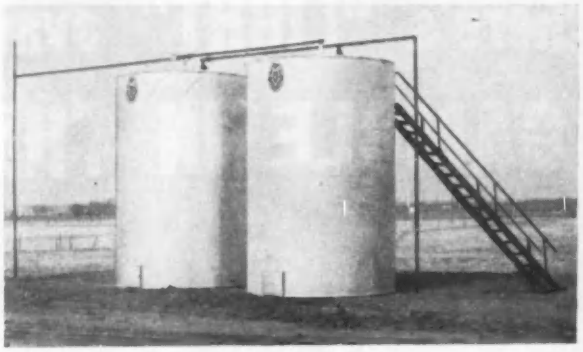

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M & V Tanks represent the most rigidly high standards of design, materials, and workmanship. Vapor tight without inspection or maintenance, they are outstandingly permanent and trouble-free.

Delivery and installation are fast and dependable. A complete stock is maintained. M & V Tanks are a wise choice!

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Steel Fabrication for the Oil Industry

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DESIGNED, TESTED AND PROVEN IN THE OIL FIELDS

Screened Air Port

Unexcelled . . . for Outdoor Use

- DRIP PROOF
- VERMIN PROOF
- MOISTURE PROOF
- CORROSION RESISTANT
- FORCED AIR COOLED

All these features of Fieldmaster Ball Bearing Motors have been designed to overcome the rugged conditions of Oil Field requirements.

CHECK THESE OUTSTANDING ADVANTAGES.

Heavy Cast base for alignment, stability, heavy duty, double-shielded, prelubricated bearings, reduces lubrication worries, high grade silicon steel in the magnetic circuit reduces iron losses . . . Wide variety of windings provides triple ratings, dual voltages . . . high torque licks heavy starting problems. High slip is available to take care of reciprocating load requirements encountered in pumping.

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Manufactured by VALLEY ELECTRIC CORPORATION, St. Louis, 8, Mo.

be of great savings to the user, always lowering costs and often in an amount from 40 to 80 percent depending upon depths and footage drilled.

For more data, circle **No. E21** on Readers' Service Card, last page this issue.

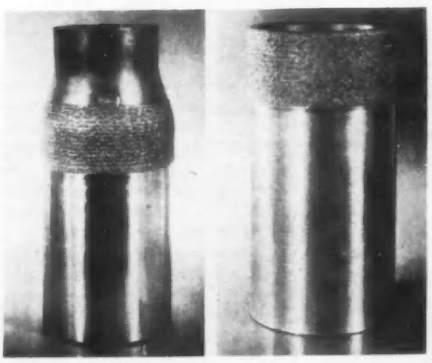
Truck-Mounted Drill

A new truck-mounted rotary drill has been announced by Schramm, Inc. Mobility and rapid set-up are two advantages of this air-drilling unit which is especially valuable in water well drilling, shot hole drilling, quarry drilling, open pit and strip mining, and railroad and highway construction.

Rotary air drilling is accomplished with the Rotadrill through a reversible hydraulic motor-driven head, mounted on a carriage that rides tracks mounted on the mast. This hydraulic head plus the special slip holders eliminate the need for a Rotary table. This means that casing can be placed down a water well and hole can be easily inspected. Sticking of the bit will not damage the hydraulic drive. Maximum down pressure is 24,000 pounds and maximum lifting pressure is 19,000 pounds.

(This item supplements Schramm, Inc. data on Pages 4662-4663 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E22** on Readers' Service Card, last page this issue.



Spang Hardfacing

New Spang hardfacing for Spangweld and Spang double seal-shrink thread tool joints is announced by The National Supply Company.

Principal feature of this abrasion-resistant hardfacing is uniform distribution of carbide granules, imbedded and bonded in the parent metal of the tool joint to form continuous overlapping protective bands.

(This item supplements Spang & Co. data on Pages 4873-4928 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E23** on Readers' Service Card, last page this issue.

New Equipment Catalogs and Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader's Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card. Requests are transmitted to the manufacturer as soon as received by us for mailing of desired information directly to you.

Slush Pump Booklet

The "Slush Pump Maintenance Manual," a 60-page publication, including approximately 150 pictures, diagrams and charts—designed to improve maintenance, handling and replacement practices with regard to fluid end pump parts—has been published by the Mission Manufacturing Company of Houston.

This very complete and comprehensive work is devoted principally to the consideration of fluid end pump parts but also takes up the pressure side of the hydraulic system, surface mud system, suction conditions and selection of drilling fluids.

To get a copy, circle **No. E24** on Readers' Service Card, last page this issue.

Power Unit Folder

International Harvester Company has made available an 8-page booklet on its extensive line of 16 power units. Entitled "International Power Units Make Your Most Profitable Power Partners," the folder depicts the use of IH power units. On-the-job photos display the units as propelling components of such varied machines as packing plant compressor, water well drilling rig and tugboat drive unit.

To get a copy, circle **No. E25** on Readers' Service Card, last page this issue.

Sand Pump Brochure

Grant Oil Tool Company has issued a new revised bulletin on the Grant sand pump. The 4-page release describes both the rod type and wire line pumps, details the applications and gives the specifications. Sizes range from 2⅛ inches through 4¾ inches.

To get a copy, circle **No. E26** on Readers' Service Card, last page this issue.

Drill Pipe Bulletin

A new bulletin on Spang drill pipe and tool joints is offered by The National Supply Co. In preparing this bulletin, data was combined on both pipe and tool joints in an effort to compile a complete, easy-to-use reference.

To get a copy, circle **No. E27** on Readers' Service Card, last page this issue.

Diesel Drilling Units

Available from the English Electric Company Ltd., Diesel Engine Division, is a new 20-page catalog DE/208. This booklet gives concise descriptive data, illustrations and performance charts on the complete line of medium speed, large bore diesels now available in 4, 6, 8, 12 and 16 cylinder engines ranging from 336 to 2,190 b.h.p.

The line features a standard size bore and stroke (10″ by 12″) with interchangeability of line parts between all engines. Featuring heavy duty design and construction, all engines are fitted with individual cylinder heads with overhead, silicon chrome steel valves, pressure lubricated. The Vee series in 8, 12 and 16 cylinder sizes, is available in either standard or turbo pressure charging either as straight diesel or Dual Fuel engines for use of either diesel or natural gas fuel.

To get a copy, circle **No. E28** on Readers' Service Card, last page this issue.

Torque Converter

A 24-page publication, Technical Bulletin 710, on their Hydro-dynamic torque converter is available from Rolls-Royce Ltd. Included are complete descriptive material including cut-away and cross-sectional illustrations, and applicational data and performance charts on various types and sizes engines on industrial installations.

To get a copy, circle **No. E29** on Readers' Service Card, last page this issue.

Pumping Unit Nomograph

The Texsteam Corporation nomograph consolidates all factors essential to an engineered selection and powering of long stroke hydraulic pumping units. Complete instructions plus the simple, heavy lined nomograph design permits a rapid calculation of hydraulic pumping unit requirements by untrained personnel.

To get a copy, circle **No. E30** on Readers' Service Card, last page this issue.

Semi-Steel Valve Brochure

A completely revised 43-page bulletin (V-203, Rev. 1) covering the entire Rockwell-Nordstrom semi-steel valve line has been issued by Rockwell Manufacturing Company.

The new bulletin, which supersedes a 35-page earlier edition, has a number of entirely new features including: (1) two full pages of photos, drawings and detailed description of Rockwell-Nordstrom lubricants and lubricating methods; and (2) large cutaway photos showing in detail the working parts of four principal types of Rockwell-Nordstrom semi-steel valves—two-bolt cover, screwed-gland, bolted-gland, and multiport types.

To get a copy, circle **No. E31** on Readers' Service Card, last page this issue.

Heavy Duty Tractors

An illustrated bulletin giving complete descriptions and illustrations of the heavy duty truck tractors is offered by Rotinoff Motors, Ltd. Originally designed for military purposes, these units are now available for commercial applications. The larger units are built to haul gross train loads up to 200 tons at speeds up to 40 miles an hour.

To get a copy, circle **No. E32** on Readers' Service Card, last page this issue.

Two-Way Radio Folder

Maximum versatility of two-way radio units is stressed in General Electric Company's latest information bulletin on G-E Progress Line communication equipment. Bulletin ECR-458 describes "building block" design of two-way radio, explaining how components may be interchanged between station and mobile combinations to assure flexibility. In its eight pages, ECR-458 also covers adaptability of the building-block design in adding optional equipment, such as selective-signalling, selective-calling, simultaneous monitoring etc.

To get a copy, circle **No. E33** on Readers' Service Card, last page this issue.

Republic Bank Pamphlet

"Oil Property Management," a two-color illustrated folder explaining the functioning of the recently-created Oil division in the Trust department of the Republic National Bank of Dallas, is now being distributed to the Bank's customers and prospects. Outlining the need for such a division, the folder cites Republic's background as an oil bank.

A section of the folder is devoted to questions and answers pointing to many beneficial results arising from specialized handling of petroleum interests through the Oil division of Republic's Trust department.

To get a copy, circle **No. E34** on Readers' Service Card, last page this issue.

V-Belt Drive Information

A new manual containing engineering data on V-belt drives for oil field drilling rigs has been issued by the Goodyear Tire and Rubber Co. Basic information necessary for proper design of slush pump, compound and drawworks V-belt drives and realistic horsepower ratings for primary drives of drilling equipment are outlined in the 16-page brochure.

Horsepower ratings in the brochure are compatible with hp being transmitted on actual drives. Ratings are based on severe service conditions.

To get a copy, circle **No. E35** on Readers' Service Card, last page this issue.

Advertisers' Index

• Dot preceding name of advertiser indicates that detailed data on products and services of the firm will be found in current 22nd (1957) edition of The Composite Catalog of Oil Field Equipment.

A

• ACF Industries, Inc. 203
• Abegg & Reinhold Co. 246
• Ajax Iron Works 37
• Allis-Chalmers Manufacturing Co. 18
American Cyanamid Co.
Refinery Chemicals Department 210
• American Iron & Machine Works Co. 265
American Petroleum Institute 47
American Sand-Banum Co. 264a
Antara Chemicals Division
General Aniline & Film Corp. 247
Avondale Marine Ways, Inc. 163
• Axelson Manufacturing Co.
Division U. S. Industries, Inc. 133, 138-139

B

• B & W Incorporated 219c
B & W Metals Co. 263
• Baker Oil Tools, Inc. 14-15, 68
Bank of the Southwest 19
• Baroid Division
National Lead Co. 239-240
• The J. B. Beaird Co. 257
• Bethlehem Steel Co. 73, 107
• Bethlehem Supply Co. 113
• Black, Sivalls & Bryson, Inc. 23
• Borg-Warner Corp. 174
• S. R. Bowen Co. 150
• Brakesol, Inc. 271b
• Brown Oil Tools, Inc. 42
• Bucyrus-Erie Co. 26
A. M. Byers Co. 183
• Byron Jackson Tools, Inc.
Division Borg-Warner Corp. 174

C

Cable Engineering 256d
• Cabot Shops, Inc. 134
• Cameron Iron Works, Inc. 78
The Canadian Bank of Commerce 242
• Capitol Mfg. & Supply Co. 231b
Caran Engineering Corp. 256c
• Cardwell Manufacturing Co. 16
• Clark Bros. Co. 236-237
Clark Equipment Co. 235
Classified Advertising 250-251
Cleaver-Brooks Co. 243
• The Colorado Fuel & Iron Corp. 261
• The Composite Catalog 220-221
• Continental-Emsco Co. 117, 196-201
• Continental Motors Corp. 267
Continental Oil Co. 272
Corrosion Rectifying Co. 184b
• Cosasco Division
Perfect Circle Corp. 195

D

Darling Valve & Mfg. Co. 190a
• Davey, Paxman & Co. Ltd. 205
Dover Corp. 149
• Dowell Incorporated 48, 143-144
• Dresser Industries, Inc. 236-237, 244-245
• Drilling & Service, Inc. 12

E

• Eastman Oil Well Survey Co. 193
• Edward Valves, Inc. 232-233
Electro-Motive Division
General Motors Corp. 248-249
The Elgen Corp. 181
• Enardo Manufacturing Co. 259
Engineered Oil Tools, Inc. 191
• Equipment Engineers, Inc. 175

F

First City National Bank of Houston 22
First National Bank in Dallas 24
• Fluid Packed Pump Co. 156-157
The Fort Worth National Bank 177
• Franks Division
Cabot Shops, Inc. 134

G

G & H Towing Co. 41
• Gardner-Denver 13
Garrett-Bromfield & Co. 271c
General Aniline & Film Corp. 247
• General Electric Co. 20-21
General Motors Corp. 248-249
Geolograph Mechanical Well
Logging Service 216
Geophysical Survey Syndicate 271d
• Globe Oil Tools Co. 172-173
• Grant Oil Tool Co. 33
• The Guiberson Corp. 189

H

• Halliburton Oil Well
Cementing Co. 1, 34-35, 208-209
• Hands-England Oilfield Equipment Ltd. 214
• Harbison-Fischer Mfg. Co. 135
• Hercules Tool Co. 184a
The Holcombe Co. 30
• HOMCO 115
• Hughes Tool Co. 109-110, 278

I

The Ingalls Shipbuilding Corp. 219a
The International Nickel Co. 27, 180

J

• Jensen Bros. Mfg. Co. 186
• Johnston Testers, Inc. 17
• Jones & Laughlin Supply Division 227-230
• Justrite Manufacturing Co. 219b

K

• K & G Oil Tool & Service Co. 254
Kern Instruments Inc. 231a
• Keystone Supply Co. 256b
• King Oil Tools 202
• M. M. Kinley Co. 194a, 268a
• Kinzbach Tool Co. 204

L

• Lane-Wells Company 118, 277
• Larkin Packer Co. 215
• Link-Belt Co. 7
• Lone Star Steel Co. 43
• Lufkin Foundry & Machine Co. 187

M

• M & V Tank Co. 270a
• MacClatchie Manufacturing Co. 105
• Magnet Cove Barium Corp. 2, 29
Marine Fabricating & Engineering Co. 32
• Jas. P. Marsh Corp. 36
• John N. Martin Manufacturer, Inc. 137
• C. A. Mathey Machine Works, Inc. 226
• McCullough Tool Co. 255
• McKissick Products Corp. 234
• Mid-Continent Supply Co. 224-225
• Miller Sand Pump Co. 194b
• Mission Manufacturing Co. 39-40

N

The National Bank of Commerce 67
National Bank of Tulsa 264b
• National Lead Co. 239-240
• The National Supply Co. 57-60
• National Tank Co. 129
• W. C. Norris, Manufacturer
Division Dover Corp. 149

O

• Oil Center Tool Co. 76-77
• Oil Well Supply Division
United States Steel Corp. 8, 10
• D. W. Onan & Sons, Inc. 190b
• Otis Pressure Control, Inc. 212

P

• Payne Manufacturing Co. 176a
• Perfect Circle Corp. 195
• Perforating Guns Atlas Corp. 269
Petroleum Electric Power Assoc. 211
Petroleum Equipment Suppliers Assoc. 223
Hotel Pittsburgher 258c

R

Radiator Specialty Co. 188
Reading and Bates Offshore Drilling Co. 170
• Reed Roller Bit Co. 178-179
Republic National Bank of Dallas 258a
• Rockwell Manufacturing Co. 217-218
Royal Bank of Canada 238

S

• Sargent Engineering Corp. 146
• Schlumberger Well Surveying Corp. 160-161
• Schramm, Inc. 252-253
• Shaffer Tool Works 207
• H. C. Smith Oil Tool Co. 169
Southern Engine & Pump Co. 184c
• Spang & Co. 266
Standard Oil Company of Calif. 9
Standard Oil Company (New Jersey) 103
Stitt Ignition Co. 268b

T

• Technical Oil Tool Corp. 44
• Thompson Tool Co. 241
The Torrington Co. 213
Trading Post Section 250-251
• Twin Disc Clutch Co. 38

U

The Unicone Co. Ltd. 271a
• U. S. Industries, Inc. 133, 138-139
United States Steel Corp. 8, 10
• Universal Atlas Cement Co. 28
• Universal Packing & Gasket Co. 25

V

Valley Electric Corp. 270b
• Visco Products Co. 131

W

• W-K-M Division
ACF Industries, Inc. 203
Warn Manufacturing Co. 176b
• Waukesha Motor Co. 11
• Weatherford Oil Tool Co. 31
• Well Equipment Mfg. Corp. 171
• Wichtex Machinery Co. 256a
• Wilson Manufacturing Co. 99
• Wilson Supply Co. 167

Y

Young Radiator Co. 258b
• The Youngstown Sheet & Tube Co. 90

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